JPRS-UEQ-89-002
30 JANUARY 1989

FOREIGN
BROADCAST
INFORMATION
SERVICE

JPRS Report

Science & Technology

USSR: Engineering & Equipment

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

Science & Technology
USSR: Engineering & Equipment

JPRS-UEQ-89-002 30 JANUARY 1989

CONTENTS

Miscellaneous

UDC 691.33

Problems in Salvaging Secondary Resources in UkSSR Discussed

18610040a Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 3, Jul-Sep 88 pp 1-3

[Article by B. V. Shcherbitskiy, director of the Planning and Organization of Production Institute of the USSR Gosplan and doctor of technical sciences; I. M. Grushko, rector of the Kharkov Motor Vehicles and Highway Institute and doctor of technical sciences; D. A. Lurye, chairman of the Commission on Interbranch Production of the Council on Cooperation for Scientific-Technical Progress of the UkSSR Party's Kharkov Obkom; and I. G. Kondratyeva, senior scientific associate at the Kharkov Motor Vehicles and Highway Institute and candidate of technical sciences]

[Text] Using secondary resources has become one of the main challenges under the current conditions of the development of production. This is because of the significant reduction in natural raw material resources and the accumulation of wastes that occupy significant territories and are sources of environmental pollution.

The UkSSR's national economy is characterized by a high relative proportion of sectors involved in recovering and processing natural raw materials, which predetermines the formation of significant quantities of production wastes—more than 1.6 billion tons annually or more than 30 tons per member of the population. Removing and storing these wastes costs up to 2 billion rubles per year and requires an extensive amount of transport and hoisting equipment. Approximately 100,000 hectares of ground is required for dumps, sumps, and other storage facilities.

Located within the republic's territory are a set of machine building and metallurgy enterprises whose operation results in the annual formation of up to 6 million tons of spent molding mixture and more than 300 tons of slag, of which only 10 to 15 percent are used in construction. In the Kharkov region, which is one of the largest industrial areas in the UkSSR, the city of Kharkov proper and the oblast contain large dumps in which about 20 million tons of spent molding mixture and 200 tons of casting slag have accumulated, and each year the dumps are filled with 650,000 and 90,000 tons of production wastes, respectively. At the same time, up to 8 million tons of sand, gravel, and other stone materials are transported into Kharkov each year to implement construction and erection operations. A significant portion of these (up to 4 million tons of sand and 80,000 tons of gravel) could be replaced with existing wastes after they were enriched. This would make it possible to save about 4 million rubles yearly and to reduce the need for transport equipment significantly. It has been suggested that by 1990 about 100,000 tons of slag, up to 500,000 tons of spent molding mixture, and more than 400,000 tons of ash slag will be used in the Kharkov oblast. Only 3.5 of the 15 million tons of ash slag produced are presently being used. It is very important to organize the shipment of ash to users in processed form in accordance with the requirements of normative documents.

The 12th Five-Year-Plan stipulates the complete reprocessing of spent molding mixtures and slag from current production as well as those that are now in dumps. The absence of enrichment factories to modify and separate spent molding mixtures is the main reason why these wastes are being used only insignificantly at the present time. Production lines for separation, crushing, and regeneration directly in the rayons where the dumps are located must be constructed. The equipment for such lines is standard and is being used at enterprises in the metallurgy and ore recovery industries and in casting. This type of production modification will make it possible to produce fractionated spent molding mixtures and slag that may be used in road construction and as components in asphalt and cement concretes and mortars.

The construction of enterprises to produce silicate brick and materials based on slag alkali, lime, and slag ash binders (slag blocks, slag ash concrete, slag brick, etc.) directly surrounding brick dumps will have a great economic impact.

In the UkSSR measures have been developed to further expand the use of wastes from the ore recovery industry. At the Krivbass Ore Recovery Combine alone more than 100 million tons of by-products have been obtained, with 65 percent of them being hard mineral ores. More than 1 billion tons of such ore has been accumulated in the republic. It occupies an area of 13,000 hectares. Plans call for using these wastes to produce 10 million m^3 of gravel in the Denepropetrovsk oblast and 5 million m^3 in the Poltava oblast.

Wastes from the chemical and by-product coke industry (polyvinylchloride and hydrocarbon resin) are being used at the Kharkhov Motor Vehicle and Highway Institute as the basis for developing road concrete compounds that are resistant to the effect of aggressive media and for animal husbandry complexes. The durability of pavements for animal husbandry complexes is increased by introducing additives made from the production wastes into the bitumen. These substances slow the changes in the physicomechanical properties of the binder when aggressive media act upon it.

Research is underway to determine the possibility of using powdered by-products from different types of production to manufacture asphalt concrete. It has been established that ash slag material from thermal electric power plants, wastes from sugar plants, lime slimes from paper and pulp production, granite screenings, and slag from metallic manganese does not meet normative requirements with respect to a number of indicators. The quality of the specified materials can be improved by crushing them to the required dispersion and activating them with chemical reagents.

Organizing the wide-scale use of by-products requires the scientific development of theoretical and practical problems related to the science of materials.

The most widespread materials in construction are those with a conglomerate structure. These are characterized by processes of both structure formation and destruction, which results in the occurrence of internal stresses and strains. Because of this, the main requirement for by-product materials is that they have minimal stresses and strains in their different stressed states. This is accomplished by optimizing the structure of the material, above all from the standpoints of density and homogeneity. It is also important to determine the allowable deviations of the required indicators from their optimum, i.e., to determine the allowable heterogeneity relative to a number of indicators of the by-product being used.

One of the main principles entailed in processing by-products is the compound nature of the methods (physical, mechanical, chemical) used to act upon the secondary raw material and the product produced from it. In many cases, the total effect from the action of different methods in their optimum combination is not equal to the sum of the effects obtained when the specified methods are used individually.

A unified method of determining the disposal prices for wastes and industrial by-products must be developed. The lack of such a method has resulted in the insufficiently well founded designation of disposal prices by supplying enterprises. In a number of cases these prices are too high, which prevents the wide-scale use of such materials.

The policy for establishing prices for by-products should encourage production enterprises to engage in this type of production.

One of the obstacles preventing the wide-scale introduction of new building structures made by using local materials and industrial by-products is an inadequate technical standards base. Accelerating the process of confirming and developing technical standards documents will make it possible to stipulate the wide-scale use of these materials in construction.

The time has come to think about organizing large interbranch production by using by-product resources in large industrial centers. It would be advisable to create production engineering centers under the auspices of the oblispolkoms or regional centers of the UkSSR Academy of Sciences. Their duties would include conducting scientific projects, manufacturing prototype lots, and organizing industrial production. Such proposals have been presented to the UkSSR Academy of Sciences for examination, and the creation, with support from the UkSSR Gosplan, of the By-Products Laboratory at the Kharkov Motor Vehicle and Highway Institute is the first step in their implementation. The laboratory is currently conducting a set of operations to solve the problem of using wastes from small-scale metallurgy in the current five-year-plan. It has been proposed that the scale of the research conducted at the laboratory be expanded as a part of the expansion of its material and technical base and that practical recommendations be made to enterprises not only in the Kharkov region but in other industrial regions throughout the republic as well.

The use of secondary resources is thus an urgent national economic task. The main barrier to the use of these resource is the lack in many oblasts throughout the republic of a buyer to not only conduct scientific research operations but also to organize production enterprises. It would be advisable for the directive organs to legislate an organizational structure for production engineering centers to salvage secondary resources.

UDC 001.5:621.7

Progress in Basic Sciences—Foundation for Creation of New Production Processes

18610036a Moscow MASHINOVEDENIYE in Russian No 43, Jul-Aug 88 pp 3-11

[Article by K. S. Kolesnikov, Moscow]

[Text] Machine building is currently faced with great and complicated tasks: raising the quality of the machines being produced and increasing production efficiency. Raising labor productivity 2 to 2.5-fold and significantly increasing the quality of the machines being produced is only possible by making use of scientific progress and improving management methods. Scientific discoveries and basic scientific results have always been the foundation on which new technology, new types of production, and even whole sectors of the national economy have been created. Machines and instruments that in principle could not have been created by using old methods have been created on the foundation of basic scientific results. In the 1930's, for example, the discovery of a method of producing synthetic rubber made it possible to create wide-scale production in the country and to provide the automobile industry with tires and the national economy with a wide range of products based on synthetic rubber. Our country was opportunely freed from dependence on foreign firms. The discovery of the century—fission of an atomic nucleus—quickly led to the creation of a great number of scientific laboratories, organization of the uranium recovery industry, creation of production based on uranium enrichment, development of nuclear reactors, and production of electric power from nontraditional sources.

It is as if many new technologies are born at the junction of different scientific directions. The joint efforts of scholars working in the field of crystallography and chemical technology thus made the creation of semiconductors possible. The combination of inventions in the fields of semiconductors, thin films, and metallurgy resulted in the appearance of microelectronics and integrated circuits. These works made it possible to transfer electronics and instrument making to a new component base and stimulated the organization of new types of production and new technologies for creating semiconductor instruments.

The binary counting system and electronics technology and control were the basis for the creation of computers that, together with nuclear power, can justly be considered to be the leading achievement of science. Basic work done by physicists in studying the properties of materials under high pressures resulted in the development of a number of highly effective production processes. One of the most important is the synthesis (1958) of artificial diamonds—the biggest achievement of domestic basic science. Right after the diamond, it was possible to produce boron nitride (borazon), the second hardest material after diamond. At normal pressures boron nitride has a graphite-like complex structure. High pressures and temperature causes its layered structure to change into a diamond-like structure. The mass production of synthetic diamonds and other ultrahard tool materials such as "elbor" and "slavutich" made it possible to achieve a big quality jump in tool production and to significantly increase the quality of the surface layer of components being machined.

The creation of synthetic diamonds and other ultrahard materials is not the only place where high pressures have been put to use. When treated with a pressure of 10 to 20 kbar, metals and other materials acquire completely new and often unusual properties. Such brittle materials as tungsten and molybdenum become plastic and can be used to produce components with a wall thickness of fractions of millimeters. When combined with high temperatures, high hydrostatic pressure makes it possible to eliminate internal defects in components in the form of blisters, cracks, etc.

High pressures exerted by compression from all sides are used for hydraulic and gas extrusion, i.e., to extrude high-precision profiles from hard-to-work materials.

Yet another direction in high-pressure technology is that of working materials by explosion. This method has long been used in breaking up mineral ores. Today the energy from an explosion is being used increasingly widely in machine building. A technology for sheet stamping using explosions was developed in the fifties. The main advantage of this technology is its economy. Using explosions has made it possible to harden many metals and alloys significantly. Work done by scholars from the Siberian Department of the USSR Academy of Sciences and the UkSSR Academy of Sciences showed that this method may be used to harden metal in a layer up to 40 to 50 mm thick, with the surface hardness being doubled in a number of cases. Explosion welding is also very effective. This method is very valuable in that it can be used to join all metals and alloys, including those that cannot be welded by any other method. The explosion method is especially important in producing bimetals, for example, steel-titanium, steel-aluminum, etc. These materials are widely used in chemical machine building. Explosion technology is very efficient. In many cases it increases labor productivity 10- to 20-fold or more. Explosives do not necessarily have to be used for the explosion. The blast shock wave may be produced by using electricity. An electric discharge is used for the the electrohydropulse pressing of pipes as well as in creating ultradispersed powders, crushing nonmetal materials, producing and calibrating components made of sheet materials, and cleaning castings.

Magnetic pulse machining, where a strong magnetic field gives a component or blank the necessary shape, has become increasingly popular in the past few years. In a number of cases magnetic pulse technology is the only method of manufacturing certain components. Automated magnetic pulse lines that produce resistors and fuses with a productivity of 2,000 units per hour already exist in the electrical engineering industry. The progress that has been achieved in machine mechanics, physical metallurgy, the theory of plastic deformation, crystallization, and thermodynamics has served as the basis for the development of the progressive production processes of the helical and tapered rolling of bodies of revolution and pinions with the subsequent formation of teeth, computer-controlled rolling of complex periodic profiles from alloyed steels and titanium, die forging, and die casting. They have also served as the basis for new molding machines and mixtures; the technology of casting large and complex components from alloyed steels with reduced allowances for machining; new types of welding and high-productivity welding technology; and methods of inspecting materials by using ultrasound and acoustic emission, holography, roentgenoscopy, and β-

15 years has resulted in the birth and introduction of a new branch in machine building technology: laser technology. The term laser technology refers to welding, cutting, surface treatment (hardening, alloying, surfacing), machining ultrahard materials, and seaming openings in watch stones. It is common knowledge that lasers can be used to produce exceptionally high densities of radiation power that are not attained by other power sources—as high as 10^8 to 10^9 W/cm^2 in a continuous-wave mode and as high as 10^{16} to 10^{17} W/cm^2 in a pulsed mode. Hence the unique possibilities for using laser radiation in machining technology. The density of the radiation power (ρ) and the duration of the effect (1) are the most significant parameters, but the nature of the process also depends on the properties of the material itself. Figure 1 shows the energy spectrum of the effect on metal with different forms of laser technology.

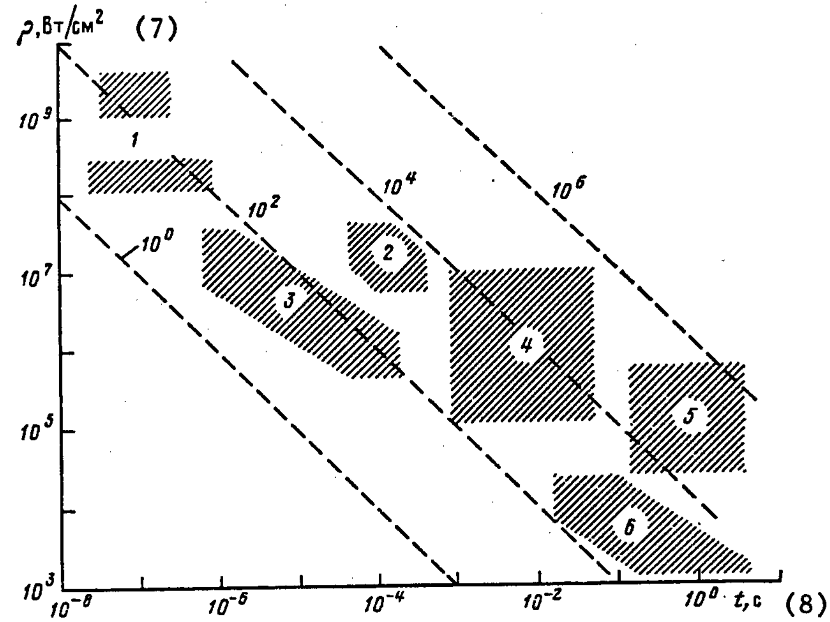


Figure 1. Energy Spectra of Different Types of Laser Technology (Slanted broken lines designate lines of different specific power in J/cm^2.)

Key: 1. Impact actions 2. Seaming openings 3. Alloying and fusing a surface 4. Welding and cutting 5. Coatings with surface fusion 6. Hardening by phase transformations 7. W/cm^2 8. time (seconds)

and γ-radiation. These and other processes have helped increase the efficiency of blank production. Bringing together machining technologists and specialists in developing machine tools and production equipment, planning and organizing production, creating robots and control systems, developing microprocessor technology, using computers, and creating software make it possible to create flexible manufacturing systems with multilevel control that are capable of operating and being readjusted automatically under the observation of repairer-operators.

The progress that has been made in the development of the physics and technology of lasers during the past 10 to

Laser machining entails rapid surface scanning by a continuous-wave or pulsing laser beam. A high-power laser beam causes the local fusion of a thin surface layer, whereas those layers of material lying beneath the surface remain cold. The fused surface layer is subjected to rapid cooling through dense contact with a mass of cooling material on the interface, which results in the formation of metal structures that include amorphous, metastable, and supersaturated phases. The calculated cooling rate in layers of nickel 0.001 mm thick that are subjected to laser machining is about 10^8. Laser machining of surfaces may be used to increase materials' resistance to wear, corrosion, erosion, and fatigue. Production lines for the laser cutting and welding of different components have been created. Lasers are used to seam openings having a diameter of tenths of a millimeter, including those in ultrahard materials, as well as for the surface heat treatment of metals, surface alloying and vitrification, the creation of protective coatings, and the hardening of welded seams. Combining lasers, computers, and holography promises to expand the capabilities of spectroscopy and permit three-dimensional research of the structure of complex molecules.

Ion implantation of metals and alloys has developed rapidly and found wide-scale application over the past several years. Ion implantation is a production process in which ions (atoms deprived of all or a portion of their electrons and that therefore possess a positive electric charge) of some substance are accelerated to high speeds and introduced (driven) into the near-surface layers of metals and alloys, where another alloy is essentially created. This method may be used to create a previously specified alloy in the surface layer of material. Right behind the production of semiconductor instruments and integrated circuits, ion implantation is increasingly capturing machine builders' attention because of the extensive possibilities that it affords relative to changing the properties of components' surface layers.

The device depicted in Figure 2 is used for ion implantation. An accelerator is used to produce a high-energy ion beam (usually tens to hundreds of kilowatts) of some previously selected element. The ions are introduced into the surface layer of the component being machined. This introduction results in the formation of an alloy without the formation of the sharp interface surface that is characteristic of many coating methods. It is generally possible to concentrate the element being implanted by 50 percent to a depth of hundreds or thousands of angstroms. It has been established that ion implantation improves those characteristics of building materials that depend on the state of the surface layer, such as wear resistance, fatigue life, and antifriction and anticorrosion properties. Compared with other existing methods of alloying, ion implantation is a very universal physicochemical method of modifying the surface layer of material. Ion implantation makes it possible to introduce atoms of any element into any specified material with no adhesion or diffusion problem. Ion implantation may be performed under conditions of comparatively low temperatures. The fact that the process of ion implantation does not require any preliminary preparation of the surface, allows full automation, and affords good reproducibility of the properties created in the surface layer of metals and alloys is very important to its industrial use.

Electrospark alloying is well recommended in places requiring local alloying of a small surface (fractions of a millimeter or more) with no need to protect the rest of the component's surface. Electrospark alloying or electroerosion surface layer formation is an electrophysical method of machining that is based on the use of concentrated fluxes of electric energy. When metal surfaces are alloyed by using the electric method, there is an electric erosion and polar transfer of the material of the anode (the tool) to the cathode (component) as pulsed discharges pass in a gaseous medium. Residual stretching stresses may occur during electrospark alloying. To avoid a reduction in fatigue strength after electrospark alloying, it is advisable to use surface plastic deformation.

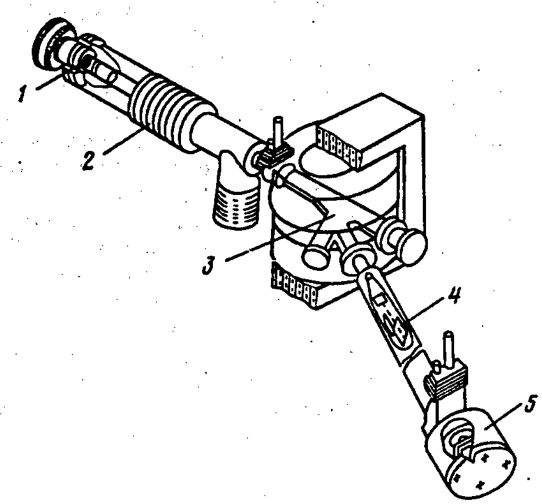


Figure 2.

Key: 1. Ion source 2. Ion accelerator 3. Ion mass analyzer 4. Beam-scanning system 5. Receiver (surface being machined)

Extensive research on plasma and attempts to introduce plasma technology began at the end of the 1950's. Plasma is partially or fully ionized gas in which the density of the positive and negative charges is practically identical and the total charge equals zero. Plasma conducts electricity and may be low or high temperature. Low-temperature plasma is used in plasma technology. Low-temperature plasma (with a temperature on the order of 10^3 K) forms during an electric discharge in a gaseous medium: an arc, glow, or spark discharge, etc. The high concentration of energy in a small volume and the high temperature of the medium over a wide range of working pressures that are characteristic for plasma have not only made it possible to accelerate traditional processes but have also made it possible to create new technologies that would have been impossible under ordinary conditions. An entire set of plasma generators with a power beginning at 1 kW and going up to 10,000 kW for cutting different fabrics (primarily silicate and capron fabrics) to process toxic wastes of the chemical industry into a consumer product has been developed in our country.

The plasma cutting of metal and plasma spraying of the surfaces of components and tools has enjoyed wide-scale use in machine building. Unlike surface alloying (laser, ion, diffusion), in which new alloys and phase compounds are formed in the surface layer, plasma coating is intended to create surface films or a significant thickness of layers with a composition and structure that are different from those of the base material. In surface alloying the material of the base is a component of the alloy, i.e., its basis. When coatings are applied, on the other hand, the surface layer formed consists solely of the material being applied. There are two fundamentally different plasma methods of applying coatings: under atmospheric conditions and in a vacuum.

During plasma application of coatings under atmospheric conditions, the material of the coating is introduced into the plasma generator's plasma stream in the form of a powder or molten wire. There it is heated intensively and fused, after which it is atomized and transported at high speed to the base on which the coating is being formed. Having come to replace the less productive method of gas plasma spraying, this method has commanded strong positions in other branches of machine building.

The complexity of the high-speed physicochemical processes occurring during plasma spraying have stimulated theoretical and experimental research. In particular, under the direction of M. F. Zhukov, corresponding member of the USSR Academy of Sciences, the country's first automated experimental stand for comprehensive research on high-temperature plasma streams was built at the Thermal Physics Institute of the Siberian Department of the USSR Academy of Sciences. Successful research has already begun on this stand.

The plasma spraying of coatings in a vacuum requires vacuum chambers, which limits the overall dimensions of the surfaces being machined but which affords qualitatively new capabilities. Plasma is passive under atmospheric conditions, whereas vacuum plasma methods provide the capability of generating active plasma, i.e., plasma of the materials being sprayed. Plasma accelerators may be used successfully in a transition to a vacuum. They make it possible to achieve an energy of up to tens of thousands of electron volts per particle and to reach an energy flux density of as much as 10^9 W/cm^2. Electromagnetic plasma systems have a high productivity, permit provide good control of energy flux density and of the speed and density of the mass flux, have a long operating life, and are economical. A technology has been developed for plasma-spraying special wear-resistant powder onto the blade surfaces of propellers manufactured from inexpensive steels. Such propellers are more resistant to cavitation wear and are several times less expensive.

Plasma metal working is being used with increasing frequency. Its essence lies in disordering the surface in front of a ceramic cutting tool. This makes it possible to increase the speed with which components are machined and to remove thicker shavings.

And now a word about powders. The use of metal in powdered form to manufacture machine components resulted in the formation of a new direction in machine building technology that is, not entirely correctly, referred to as powder metallurgy. The technology of producing components from powders is based on the latest progress in physical, physical chemistry, and engineering technology. It has, in principle, changed the scheme of metal production that has evolved in machine building and has eliminated such traditional processes of working metal as melting, casting, forging, and cutting, which require up to two-thirds of the total labor expenditures. All of these processes are replaced by automated pressing and sintering. The result has been a sharp increase in the utilization factor of metal and a reduction in labor intensity coupled with an increase in product quality.

Today the technology for producing components from powders is experiencing a real boom in the area of new ideas, developments, and technological decisions. Interesting works are underway at the Materials Science Institute of the USSR Academy of Sciences, for example. They have made it possible to significantly increase the low-temperature plasticity of such traditionally brittle metals as chromium, molybdenum, and beryllium and to simultaneously create ceramic and ultrahard diamond materials with increased viscosity. Reinforcing powdered mass with nonmetallic components (oxides, carbides, different organic fillers, and high-strength fibers) has resulted in the creation of a new class of materials: composites. They include carbon plastics (aluminum-coated carbon fibers, metal-reinforced plastics) and thin metallic threads of aluminum, magnesium or titanium. Such materials possess the properties of fibers as well as those of coatings. An entire series of very new composites produced by methods of hot pressing from powder has been created. Composites of the type iron-copper, iron-chromium-copper, nickel-aluminum, titanium-nickel, etc., are being introduced into industry on an increasingly wider scale.

Powder technology is not, however, limited to the manufacture of components from metal powders. No less important is the spraying of a metal surface with a metal-clad layer of refractory, wear-resistant, and corrosion-resistant materials. First, this provides the possibility of virtually completely regenerating worn components. Second, spraying metal powders sharply reduces metal losses due to corrosion (between fivefold and sixfold). New protective coatings reduce the volume of the galvanic treatment required for components and thus the amounts of harmful industrial wastewaters produced, and they reduce the expenditures required for cleaning facilities. For example, using the electric arc method to apply a metal coating to structures subjected to atmospheric corrosion and the effect of water provides a repair-free service life of 20 to 30 years.

Using powdered coatings to regenerate and harden machine components gave rise to the so-called gas thermal processes of applying coatings, including the gas-detonation method of applying coatings. The method entails detonation combustion of a gaseous mixture, the production of combustion products having high temperatures and great speeds for a physicochemical transformation of powdered materials (structural and phase transformations, oxidation, fusion, crushing, burning, etc.), and their transportation to the surface of the component being machined. This method makes it possible to produce high-quality coatings for different purposes. Its main advantages are that it provides the capability of forming a strong bond, it does not impose high requirements from the standpoint of surface preparation, and it has a high productivity. Its disadvantage is its high noise level.

So-called vacuum methods of applying coatings have been used increasingly more widely in recent years. The essence of the process lies in the fact that the material required (metal, oxide, carbide, etc.) is vaporized by heating in a deep vacuum and the vapor thus formed is condensed in the form of a thin film on the surface of specified materials. A fundamentally new technology, the so-called vapor-phase technology, has been formulated on the basis of this method. This technology makes it possible to create very complicated and modern coatings with new structures and previously specified properties. The process is ecologically clean.

Precipitation methods differ from the standpoint of the method used to vaporize the material being applied: thermal precipitation (Figure 3a), in which the substance being deposited is vaporized from a crucible by heating it (by the induction method, for example); cathode spraying (Figure 3b), when the substance being deposited is vaporized by ion bombardment of the cathode target during the course of a gas discharge; and ion cladding (Figure 3c), in which the substance is deposited on the base by thermal vaporization and the base is subjected to bombardment by high-energy ions before and during the process of forming the layer. Laser surface treatment (laser alloying) is used to increase the strength of the bond between the coating and base.

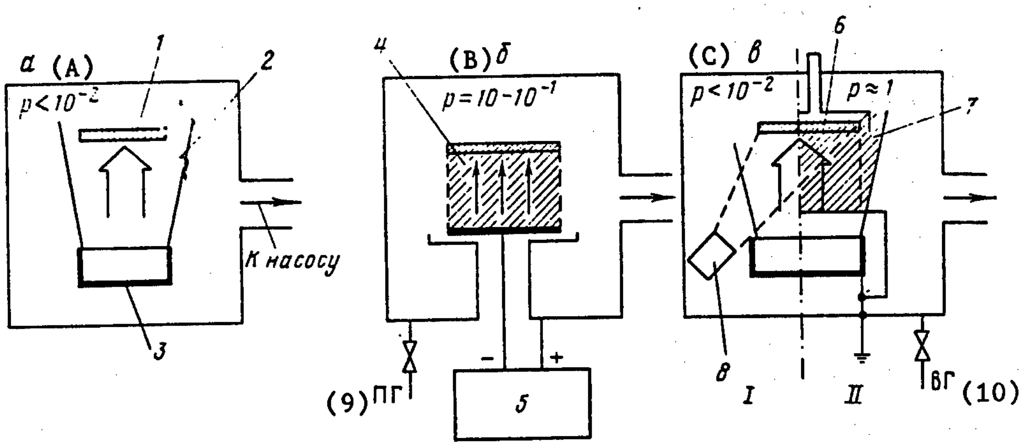


Figure 3.
Key: 1. Base 2. Vapor stream 3. Evaporator 4. Gas discharge phase 5. High-voltage source 6. High voltage 7. Gas discharge plasma 8. Ion source 9. Gas line 10. Gas inlet I. Separate receipt of ions II. Independent receipt of ions

Vapor-phase technology has already proved its efficiency in optics for creating reflective, protective, light-separating, and different types of multilayer interference coatings; in electronics and radio measurement technology for producing photoresistant, photomultiplier tubes, cathode ray tubes, and power attenuators; in computer technology for manufacturing thin magnetic films; and in microelectronics for manufacturing integrated circuits, etc. Under industrial conditions, aluminum is successfully applied onto steel band from the vapor phase with subsequent cold dressing. Vapor-phase technology makes it possible to create materials consisting of thin alternating layers similar to veneer. The high-temperature strength of the alloy constructed in a similar fashion from microlayers of iron and light-alloy copper is many times greater than that of pure iron.

Technical progress always has and always will be connected with materials. Indeed, it is materials that are the revolutionizing factor in improving machines, raising their quality, and creating new machines. In many respects it is materials that are responsible for mankind's assimilation of space and for the development of nuclear power, electronics, etc. It is no exaggeration to say that the creation of high-quality metals and alloys, polymer materials, and ceramics is the main direction of scientific-technical progress today. The first to develop new building materials with specified characteristics and introduce them into the economy on a wide scale will undoubtedly be the one to possess the greatest technical and economic potential.

The problem of materials must not be viewed in isolation from technology. Materials and technologies always go hand in hand. The progress that has been made in inorganic chemistry, chemical thermodynamics, high-pressure physics, and high-temperature physics has been the basis for creating new materials and new technologies for producing them. For decades titanium was used solely to alloy steel and produce titanium white. The technology developed for producing pure titanium immediately resulted in a class of building materials that are very important for aviation and for the chemical and power engineering industries. Metals such as chromium, tungsten, molybdenum, tantalum, bismuth, zirconium, etc., were long considered brittle. Purification technology revealed not only their high plastic properties, but a whole series of other very valuable qualities that they possess. In fact, thanks to an improvement in the technologies, it was as if these materials were rediscovered, after which time they began to be widely used in a number of branches of industry. Methods and processes for producing polymers and building plastics were developed on the basis of basic research. Many types of thermoplasts used in industry already exist. These include polymers intended for general technical use (polyethylene, polypropylene, polystyrene, polyvinylchloride, polyurethane, acrylic resins, esters, and celluloses); polymers intended for use in domestic engineering (polycarbonate, polyamides, etc.); and relatively new thermoplasts possessing high strength in combination with good antifriction and electricity-insulating properties as well as reduced combustibility. Composites produced by using a special technology and representing a combination of metal and polymer or metal and ceramic as well as composites strengthened by directed meshes, threads, fibers, and various dispersed materials show even greater promise. Composites are significantly stronger, more heat resistant, and more resistant to abrasion and erosion, and they show a greater inertness to aggressive media. Thanks to this, they have successfully replaced cobalt, nickel, chromium, molybdenum, niobium, tungsten, and ferrous and nonferrous metals and their alloys, all of which are in short supply.

And now a few words about another material of the future: ceramics. Technical-grade ceramics are a class of materials based on compounds of the most widespread elements in nature —nitrogen, carbon, silicon, oxygen, aluminum, titanium, and a few others. They surpass metals from the standpoint of chemical and thermal stability and mechanical strength. They are only inferior in one respect—they are too brittle. If this flaw can be overcome, we will be on the threshold of the rapid development of a number of areas of technology, above all engine building. Manufacturing the most temperature-stressed components of gas turbines from ceramics will make it possible to raise the temperature of the working body, increase its efficiency, and reduce fuel consumption. Ceramic cutting plates permit a two- to fourfold increase in cutting speed and in machining quality as compared with plates made of scare tungsten hard alloys.

Together with metallic materials and resin-based materials, ceramics are becoming the third building material in machine building.

Bibliography

1. Belyanin, P. N., "Production Methods of Increasing Life and Reliability of Machines," in "Problemy nadezhnosti i resursa v mashinostroyenii" [Problems of Reliability and Life in Machine Building], Moscow, Nauka, 9186, pp 69-86.

2. Dorodnov, A. M., "Promyshlennyye plazmennyye ustanovki" [Industrial Plasma Units], Moscow, Rotaprint MVTU, 1976, 127 pages.

3. Zhukov, M. F., Lyagushkin, V. P., and Solonenko, O. P., "Avtomatizirovannyy eksperimentalnyy stend dlya kompleksnogo issledovaniya vysokotemperaturnykh geterogennykh struy (sostoyniye i perspektivy)" [Automated Experimental Stand for Comprehensive Research on High-Temperature Heterogeneous Stream (State of Art and Prospects)], Preprint No 145-86. Institut teplofiziki, SO AN SSSR, 1986, 71 pages.

4. "Zashchitnyye pokrytiya na metallakh" [Protective Coatings on Metals], No 20, Kiev, Nauk. dumka, 1986, 100 pages.

5. Kudinov, V. V. and Ivanov, V. M., "Naneseniye plasmoy tugoplavkikh pokrytiy" [Application of Refractory Plasma Coatings], Moscow, Mashinostroyeniye, 1981, 192 pages.

6. Marchuk, G. I., "Technology—Material—New Technology," NAUKA I ZHIZN, No 9, 1985, pp 2-8.

7. Mirkin, L. I., "Fizicheskiye osnovy obrabotki materialov luchami lazera" [Physical Bases of Machining With Laser Beam], Moscow, Izd-vo MGU, 1975, 383 pages.

8. Rykalin, N. N., et al., "Lazernaya i elektronnoluchevaya obrabotka materialov" [Laser and Electron Beam Machining], Moscow, Mashinostroyeniye, 1985, 496 pages.

9. Namba, S., ed., "Ion Alloying Technology" (translated from Japanese under the editorial supervision of P. V. Pavlov), Moscow, Sov. radio, 1974, 160 pages.

10. Petrov, Yu. N., ed., "Elektroiskrovoye legirovaniye metallicheskikh poverkhnostey" [Electrospark Alloying of Metal Surfaces], Kishinev, Shtiintsa, 1985, 196 pages.

UDC 621.314

Increasing Efficiency of Use of Production and Scientific Potential in Machine Building
18610040b Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 3, Jul-Sep 88 pp 3-6

[Article by P. G. Pererva, candidate of economic sciences]

[Text] The second republicwide scientific-technical conference entitled "Scientific-Technical Progress and Increasing the Efficiency of the Use of Production and Scientific Potential in Machine Building" was held in Kharkov in December 1987. It was organized by the UkSSR Ministry of Education, UkSSR Gosplan, Ukrainian republicwide and Kharkov oblast scientific-technical societies of the machine building industry, and the Kharkov Polytechnic Institute imeni V. I. Lenin.

Under the conditions of the transition of the machine building sectors to full cost-accounting and self-finance, the problems entailed in making effective use of production and scientific potential have acquired special urgency. The introduction of new management methods and the restructuring of its operation have entailed definite difficulties. Above all, these include the unsatisfactory pace at which machine building production is being updated, its unsatisfactory level of competitiveness on the world market, and the comparatively long period required to prepare and launch the production of fundamentally new implements of labor.

Overcoming these difficulties requires the integrated accomplishment of a number of economic organization tasks. The most important of these are the development of scientific-technical progress in the machine building complex, in particular, increasing the efficiency of systems to manage the development, production, and operation of fundamentally new machine building production, and the improvement and updating of the technology based on transitional principles of operation and management.

At the conference it was noted that definite progress has been made in relation to the theory and practice of managing the development, production, and operation of machine building production over the past few years. Forms for organizing its creation based on special comprehensive programs and interbranch scientific-technical complexes are being developed with ever-increasing efficiency. Comprehensive systems for controlling the efficiency of production and product quality are being introduced on a wide scale, which is facilitating an increase in the technical level of machinery and mechanisms. Throughout the republic as a whole, however, the relative portion of machine building technology certified as belonging to the highest quality category fell from 42.30 percent in 1985 to 37.82 percent in 1986, and in the first half of 1987 it amounted to 40 percent. The introduction of the state acceptance for products at the country's machine building enterprises is facilitating an increase in product quality, an improvement in labor organization, and a rise in production discipline.

In his report, N. I. Krasnokut (Kiev) indicated that from 1980 to 1986 the republic's machine building complex experienced a nearly 3-fold increase in its park of numeric control machine tools, a 12.6-fold increase in the number of automatic manipulators, and the introduction of 124 flexible manufacturing modules. This potential is not, however, being put to adequate use. Thus, according to data from a 24-hour observation (on 14 May 1987) conducted by the UkSSR State Committee for Statistics, the shift coefficient for all metal working equipment was 1.36. It was 1.36 in basic production, 1.57 when numeric control machine tools were included, and 1.67 when machining centers were included.

In view of the shift coefficient achieved and the presence of significant idle time during shifts (based on data from surveys of a number of machine building enterprises in Kiev, Kharkov, Odessa, and Lvov in 1987, it amounts to 35.2 percent), modern highly productive but expensive equipment is being used inefficiently. According to a report by N. I. Pogorelov and Ya. B. Lymar, research conducted at a number of machine building enterprises in Kharkov showed that automated lines are not generally being used at more than 50 to 60 percent of their design productivity. The functional principle of servicing automated lines that is currently being practiced has resulted in a situation where mechanics and maintenance men are busy for only 65 to 70 percent of their time at work, electricians are busy 70 to 75 percent of the time, and repairmen are busy 60 to 65 percent of the time. Furthermore, automated lines stand idle awaiting adjustment or repair up to 40 percent of the time. This is mainly due to inadequate organization of the work of service personnel.

In the opinion of those participating in the conference, the process of updating production is proceeding slowly. In the first half of 1987 this indicator amounted to 5.3 percent versus 7.6 percent of the figure stipulated by the plan. The machine building ministries have not fulfilled their plan for developing science and technology. Between January and June 1987 the state quotas for putting the most important types of machinery and equipment and new technologies into use were only 80 and 93 percent met, respectively. The experience that has been accrued relative to creating temporary labor collectives on a cost-accounting basis to solve scientific-technical problems is noteworthy. In the third quarter of 1987 alone, temporary labor collectives in Kharkov, in whose ranks more than 350 scholars, designers, technologists, and workers were brought together, completed and launched the production of 28 developments at a cost of 330,000 rubles and with an economic impact of more than 2 million rubles.

In his report, I. Ya. Grishin, head of the scientific research department of the Kharkov Tractor Plant imeni S. Ordzhonikidze, indicated that each year the enterprise concludes economic agreements to undertake scientific research developments with 60 to 70 scientific organizations and that only 10 to 17 of them are introduced. The level of scientific research work conducted by higher educational institutions is especially low. In Grishin's opinion, the main reason for this is the absence of a good experimental base in higher educational institutions. Without such a base, the strong labor force potential cannot work with the output required. The speaker feels that the solution to this problem lies in transferring the management of those unprofitable, small ones, i.e., those with a production volume from 1 to 15 million rubles, to higher educational institutions.

In their report, A. Yu. Rudchenko and Ya. B. Usenko (Kiev) noted that in the past 10 years the increase in the number of workstations in the UkSSR outpaced that of the work force (130.1 and 124.3 percent, respectively). Two principal directions for solving this problem were established in the report. The first is to increase the shift coefficient of progressive equipment and thereby take obsolete technology out of operation, which would in turn increase the capital-output ratio in the republic's machine building sector by at least 25 percent as compared with 1985. The second direction is to further intensify and develop specialization of production. Calculations show that 1.3- to 2.4-fold fewer workers are used in specialized casting shops than in nonspecialized shops. Specialization of casting production from the standpoint of casting method (technology) and the production of castings will make it possible to free more than 14,000 persons in the UkSSR's machine building sector. To solve this problem, B. A. Pisarenko (Zhitomir) suggests improving the methodological basis for certifying and rationalizing workstations by using a workstation profitability indicator. His report presents an economic justification of the optimal value of this indicator for different types of production and working conditions.

The conference participants paid special attention to flexible production systems, particularly to problems of making an economic assessment of the expediency of their use. In his report, N. S. Sachko (Minsk) points out that the main ways of increasing the efficiency of flexible manufacturing systems that are, in many cases, unprofitable is to improve and reduce the cost of production, warehouse, transport, and electronic equipment by manufacturing it from series subassemblies and components and to ensure the full use, serviceability, and reliability of the equipment.

As far as the problem of the reliability of fundamentally new technology is concerned, N. F. Revenko (Kramatorsk) noted that the level of this very important indicator is still low. Thus, if the mean time between failures for a universal machine tool is taken to equal 1, it is between 0.4 and 0.6 for numeric control machine tools, between 0.3 and 0.4 for robotized production complexes, and between 0.25 and 0.3 for automated lines. To get a full return from flexible manufacturing systems their mean time between failures should be 8 to 10 times greater than that of universal machine tools.

New machinery and equipment should be introduced before any economic calculation of the effectiveness of its use is made. In the opinion of A. I. Yakovlev (Kharkov) and S. F. Pokropivnyy, A. S. Fedonin, and A. V. Savchenko (Kiev), however, the currently existing method of determining the economic effectiveness of new technology is far from perfect. The use of this methods results in a significant number of errors in calculations and disparities in discussions of results based on the method. There is an urgent need to make a substantial improvement in the existing method or to develop and approve a new method for determining the economic effectiveness of new technology that allows for such factors as the elements of social effect; changes in physical, financial, and labor resources throughout all stages of the new technology's life cycle; and its effect in the realm of product consumption.

At the conference, a great deal of attention was paid to the problems of managing scientific-technical progress at different levels and increasing product quality under the new management conditions. The speakers' proposals dealt with expanding scientific-technical associations' rights and capabilities of implementing the new conditions and with the need to create a full cost-accounting fund for scientific-technical development in the associations. It was also noted that machine building enterprises will get the best results if they have stable fund formation standards and if the differentiations between enterprises that definitely tend to impede scientific-technical progress at well-operating enterprises are eliminated. There was also a proposal to introduce a system for certifying existing technologies from the standpoint of their scientific-technical level and quality. The incentives provided to specialists and enterprise directors would be dependent upon this system.

Based on the results of the work done at the conference, specific recommendations were made for increasing the efficiency with which the production and scientific potential is used in the machine building sector under the new management conditions.

UDC 384.4;66-947

Restructuring Moscow Industry for Intensive Path of Development

18610027b Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 7, Jul 88 pp 35-37

[Article by Ye. T. Larina under the "USSR Exhibition of National Economic Achievements" rubric: "Restructuring Moscow Industry for Intensive Path of Development"]

[Text] Nine sections of the exhibition entitled "Restructuring Moscow Industry for an Intensive Path of Development," which was held from November 1987 to

March 1988, introduced visitors to the experience that has been accumulated by Moscow enterprises in fulfilling the quotas of the 12th Five-Year-Plan on the basis of the integrated mechanization and automation of production and an improvement in the organization of labor.

The section entitled "Integrated Mechanization and Automation of Production" revealed the tasks facing the city's industrial enterprises in the 12th Five-Year-Plan during restructuring for an intensive path of development though integrated mechanization, an increase in labor productivity, reductions in the demand for personnel and in the relative share of manual labor, and a reduction in the amounts of power and materials required for production.

The main tasks emerging from the concept of the integrated socioeconomic development of Moscow for the period up to the year 2000 were represented by a system of citywide special comprehensive programs. It includes 23 programs geared toward solving social problems, accelerating scientific-technical progress, radically redesigning and retooling existing enterprises, and intensifying the use of scientific and production potential. The Kachestvo [quality] program may be singled out among the special programs. Its purpose was to acquaint people with the introduction of automated systems and production complexes based on the use of robotics and microprocessors at Moscow enterprises.

Plotting-board and full-scale exhibits reflected the prospects of creating and introducing automated systems at Moscow enterprises in the 12th Five-Year-Plan and the results of 1.5 years. A diagram showed the dynamics of the introduction of industrial robots, manipulators, and transfer arms between 1986 and 1990. In a special subsection one can become acquainted with the machinery and equipment operating in all stages of machine building and instrument making production as well as with materials on automated process control systems, flexible manufacturing modules, and flexible manufacturing systems, which constitute the basis of the integrated mechanization and automation of blank-stamping and casting production. In this same subsection, plotting boards and full-scale prototypes were used to demonstrate automated process control systems for machining production and mechanizing and automating assembly production.

Very diverse types of equipment for mechanizing and automating labor at enterprises in Moscow's light, food, and processing industries were demonstrated.

The section entitled "Automating Engineering Labor" occupied an important place in the exhibition. It included exhibits revealing the main trends in the area of automating engineering labor: data base management and support, computer-aided design [CAD], and programming automation systems, etc.

The tasks of data base organization and management to support developments and the design of cells and units for use in modern electronics equipment, models for casting production, etc., were demonstrated on CAD terminals connected to large computers (the YeS-1061, for example).

A universal system for the automated design and standardization of production processes is intended for use in the automated design and standardization of production processes in a mode of interaction with an SM-4 computer.

The information base required for automated design and standardization is prepared directly at the enterprise with an allowance for specific production conditions. The information base is formulated and designed by technologists and standardizers who use an uncomplicated language for describing production processes, without any participation by programmers. An applications package for design using automated methods (the PRAM 4.108) has been taken as the basis of this system. The package makes it possible to expand the system's capabilities from the standpoints of both encompassing new types of operations and increasing the size of the information base. The system has been implemented in both single- and multiple-user modes. Its output documents are a production-routing chart and a chart of time and evaluation norms.

Using the system under production conditions results in a severalfold increase in the productivity of technologists and standardizers as compared with traditional methods of developing and standardizing production processes, and it improves the quality of production and normative documentation.

The SKTsI 442.232.001 programmed assembly unit is intended for operation in assembly and erection shops and as a component in a flexible manufacturing system as well as a stand-alone piece of equipment for automated installation of an entire range of products onto the printed circuit boards of electronics products. The unit stores a shift's or day's set of electronics products in storage unit-dispensers, feeds products into the work area in synchronism while simultaneously indicating the place of its installation on the printed circuit board, etc. The yearly savings from introducing the unit is 25,000 rubles.

The Tigris interactive system for designing printed circuit boards is used to automate the start-to-finish design of two-layer circuit boards when developing products for electronics equipment. An interactive mode is provided during all stages in the design process, and this reduces the design cycle and increases the quality of the circuit boards being developed (the development cycle of a printed circuit board is reduced two- to threefold). The fact that the results of a designer's work are reflected on the screen of a graphic display in real-time permits timely evaluation of the results of the work and online intervention in the design process.

The estimated economic impact in a yearly program of 1,000 boards is 70,000 rubles.

The GRIF-3 system for automating engineering based on a program-methodological complex is intended for automating planning and design operations and for the generation of graphic and text documentation in automated workstations. This device is a set of program modules that are informationally and logically linked into a system functioning as an applications task in the environment of the RAFOS-2 operating system. The GRIF-3 engineering automation system is an original development with no domestic analogues from the standpoint of its technical data and functional capabilities. The system is used in organizations, enterprises, and educational institutions (primarily instrument making) along with first- and second-generation automated workstations.

The GRIF-3 engineering automation system supports the following: development of design objects based on a unified graphics data base that contains graphic, geometric, topological, and connective (associative) information unifying all types of representations (a functional and schematic description) of one and the same device; development of design objects in logical (schematic) and physical (design) representations and their mutual conversion; and automated implementation of sketching and graphics operations and output of sketch documentation meeting the requirements of the Unified System of Design Documentation, etc.

This section also included a number of computers whose use makes it possible to perform a large number of diverse planning and design operations directly in the engineer's workstation.

The YeS-1841 personal professional computer is used to perform a wide set of scientific-technical and economic tasks as well as create automated workstations having different professional profiles. It is also used in data teleprocessing systems and local area networks to create information and reference systems, management and clerical work systems, etc. The YeS-1841 personal professional computer may include the following modules: digital signal I/O, analog signal I/O, shared-channel information I/O, communications with a CAMAC system, and a digital speech message synthesizer. The information transmission speed in a network (the personal professional computer may be connected to a local area network based on a ring topology with the capability of connecting up to 125 users in a network) is up to 125 Kbit/s.

The GRAFIT applications package for recognizing symbolic and graphic information is intended for automatic computer recognition of manually drawn, nonstylized images containing symbolic, graphic, and mixed symbolic and graphic information. The applications package is used in computer-aided design, polygraphy, statistics, accounting, when inputting large information files into a computer, etc. The packet's operation is controlled via interaction in a menu mode and does not require special knowledge on the part of the operator.

The YeS 7920.11 complex of devices for displaying alphanumeric information is a multipanel system consisting of a set of information I/O devices connected via a central control device to a Ryad-1 or Ryad-2 Unified Computer System. The complex is intended for online I/O, editing, and preparation of information in information and reference service systems; for gathering and preparing data; and for use as operator panels in a YeS computer network.

The KORVET instructional computer technology complex captured the interest of exhibit visitors. It is intended for equipping computer technology and information science offices in schools, vocational-technical schools, and secondary special educational institutions. The purpose of the complex is to acquaint students with using a computer to perform tasks—something that is necessary to increasing labor efficiency under conditions of the wide-scale computerization of the instructional process.

The TS6030 device is used to automatically read graphic information from drawings, diagrams, and sketches containing random figures and text and to convert information into grid form. It is used in the products of computer and measurement and testing technology, information and reference systems, and CAD systems.

The system for the automated technological preparation of control programs to machine components that is based on the Aprikot personal computer makes it possible to sharply reduce the time required to develop control programs as compared with traditional methods. It is especially effective to use CAD to develop control programs when working with components having complex curvilinear profiles.

In these cases profile calculation errors are completely eliminated, the work of technologists becomes more creative, and a 10-fold reduction in labor intensity as compared with manual methods is achieved.

The system for automated sketching and preparation of design documentation that is also based on the Aprikot personal computer is intended for equipping designers' automated workstations. The system makes it possible to create all types of design documentation.

Use of the system significantly reduces the time required to develop design documentation and reduces the time required to launch new products into production. The quality of documentation is sharply increased, copying errors are eliminated, and the designer's work becomes more creative. Both systems make online changes in a design, which is especially important under conditions of flexible automated production.

The Upravleniye-GPS [Control FMS] system for automating the creation of software for microprocessor devices is used for the automated processing of formalized descriptions of algorithms for the functioning of local control devices so as to produce control programs for microprocessor controllers based on a K580IK80 single-chip microprocessor and microcomputers that are software compatible with the Elektronika-60 computer.

Unlike existing systems, the Upravleniye-GPS makes it possible for the professional programmer-technologist or designer to create software for a control device based on microprocessor technology. The system may be used when creating software for individual pieces of production or auxiliary equipment that have the capability of logical control, robotics complexes and flexible manufacturing modules, and group control devices for flexible manufacturing sections.

The system is implemented in PASCAL. Using the system reduces the time required to design software, increases labor productivity three- to fivefold, and provides an annual economic impact of over 50,000 rubles.

The CAD system for designing asynchronous motors makes it possible for the estimator and designer to interact directly with a computer, thus bypassing the intermediate stages of programming and coding. The computer performs greater volumes of computations, and the engineer-designer is freed to perform creative tasks.

When designing new series of asynchronous motors it is very important to reduce production costs, reduce the amount of materials used, and improve their operating characteristics. The asynchronous motor CAD system does all of these successfully. Using computers allows the designer to analyze more versions of a design. The asynchronous motor CAD is geared toward use with a YeS computer having an expanded peripherals complex. The asynchronous motor CAD is a base system for electrical machine building enterprises. Use of the system increases the quality of the products designed and the productivity of designers (six- to sevenfold) while reducing the cost of designs fourfold.

The CAD system for designing production processes (the subsystem Machining Bodies of Revolution) has been introduced at USSR Ministry of the Electronics Industry and Ministry of the Machine Building Industry enterprises with single-unit, small-series, or series production. The system makes it possible to copy information about components and to derive individual and standard production processes for components belonging to different complexity categories with design time norms. Their economic efficiency is reflected in their fivefold or more reduction of the times required for the technological preparation of production, increase in the quality of technological documentation, and 20 percent relative reduction in the numbers of technologists and standardizers.

A wide range of exhibits demonstrating the automation of engineering work at enterprises in Moscow's light industry were presented.

The automated production complex for the laser pattern cutting of roll materials is intended for use at enterprises in the tricot subsector of the textile and light industry as a component in an automated pattern-cutting complex, at shops or sections controlled by a plant technology management automation system, as well as at enterprises with individual and small-series production in an offline mode. The automated production complex for laser pattern cutting is a production unit with discrete-continuous action that is intended for cutting single- and double-layer textile materials as well as natural and artificial skins and cardboard.

The CAD system for the technological preparation of pattern-cutting production is used in the textile and light industries. The system automates the processes of the design preparation of products, the design of pattern layouts, and the preparation of control programs for automatic pattern cutting. Coding and duplicating one pattern takes 2 minutes, and from 2 to 5 hours is required to automatically design the layout of 20 to 40 components. Five minutes is required to construct the optimum route for a layout.

The exhibition provided an opportunity to become acquainted with software for the online planning of finishing operations with an allowance for satisfying product shipment agreements. The software is intended for calculating the production program for finishing operations for the quarter or for the month by production changes. The software supports the multiversion planning of the production of finished fabrics. The software is an interactive, multiuser system, and all of its economic and systemwide functions are executed by direct user-computer communication via a video terminal. Software from the Fobrin-2 system is used to manage the information base. Two versions of user access to the information resources and software are possible: direct connection of users to the central computer of a video terminal system and connection of the user's PC-based automated workstation via the Estafeta local area network.

The software has been developed for the SM 1420 control computer complex in the operating environment of a real-time operating system.

This section of the exhibit also included software that is used in light industry to automate online monitoring of shipment agreements and to track the movement of a finished product in the warehouse.

The software keeps records of and monitors the fulfillment of agreed-upon shipments and the movement of a finished product in a warehouse over the course of 24-hour periods as well as the cumulative result from the beginning of a month, quarter, or year.

This automation of accounting and monitoring operations is accompanied by the formulation of documents on machine carriers.

The software's information base contains data about the daily arrival of finished fabrics at the warehouse, the daily shipment to consignees, the running inventory of fabric in the warehouse of the sales department, surpluses, shortages, resorting, etc. The software has been developed for an SM 1420 control computer complex equipped with remote terminals.

The automated system for normative accounting and planning calculations (software complex) operates at the Moscow cotton combine Tryekhgornaya Manufaktura [Trimountain Manufacture] imeni F. M. Dzerzhinskiy.

The complex is intended for use in formulating a yearly and operations plan for the production of products, automation of online monitoring of production shipment agreements, and quality control of production in spinning. Its anticipated economic impact is 480,000 rubles.

The Raskladka [Layout] CAD system for the automated design of pattern layouts is intended for use in inputting graphic information about patterns into a computer memory, automatic duplication of patterns relative to sizes and increases, and the layout of patterns in sewn goods in an interactive mode and for automatic sketching. The hardware complex of the Raskladka CAD system includes an SM-4 control computer complex, an external memory based on removable magnetic disks, a PKTIO semiautomatic graphic information coder, EPT interactive graphic displays, and an Aristomat-316 graph plotter.

Introduction of the system in the sewing association Moskva and the House of Models of Special and Work Clothes resulted in a threefold acceleration of the preparation of design documentation and in creation of the prerequisites for increasing the quality of the cutting and the product as a whole.

As a result of the introduction of the Raskladka CAD system in the Moskva association there was a 0.2 percent reduction in the consumption of material and a 17 percent increase in the manufacture of products with a classification of N. Its yearly economic impact was 286,000 rubles.

Another interesting exhibit was the software for simulating a wholesale fair. The software is intended to train an enterprise in how to hold a wholesale fair and to simulate the processes of accommodating the diverging interests of a product's producer and consumer during the course of a wholesale fair and formulating agreements for a product's shipment.

The principal function of the software is to formulate an enterprise's production program under conditions of training for a wholesale fair. The source data for the software are check figures, normative-reference tables, a draft plan, and trade orders.

No programming qualifications are required of users working with the software. All source data characterizing the production and technological processes, the types of products manufactured, and the required normative indicators are preentered by using an information subsystem from a display screen (in an interactive mode). A program-initiated dialogue is the basis for all further operation. During the operating process the user deals only with a list of orders and other economic indicators. The interactive access makes it possible to change individual indicators in the plan and to select and change optimality criteria (when necessary, the results may be printed out).

Another exhibit at the exhibition, the Poliklinika (Outpatient Clinic) automated management system applications package, is intended for use in creating and managing a general data base of all medical information about an outpatient clinic's patients on magnetic carriers. Medical information is written into the data base by each user from his or her workstation via a video terminal.

The applications package operates in an interactive mode under the control of the DIAMS-3 operating system. Control computer complexes belonging to the SM computer family are used as hardware.

The number of users (both physicians and administrative personnel) that can work simultaneously in an interactive mode is unlimited. It is determined by the capabilities and specific configuration of the DIAMS operating system.

The response time to user queries given access to the personal data on each patient is 3 to 5 seconds. Introduction of the Poliklinika automated management system applications package provides a significant economic impact: the volume of office work is reduced, the reliability of medical information is increased, and quality control over medical service is improved.

The section entitled "Scientific Organization of Production, Labor, and Management" reflected the state of the art and prospects for the transition of Moscow's scientific-production and production associations, organizations, and enterprises to a new management system that includes an expansion of economic independence and a transition to full cost-accounting, self-finance, and self-support.

Economic organization and psychosocial methods of operations for associations and enterprises under new management conditions, improved use of production potential, introduction of collective forms of labor organization and incentives, brigade cost-accounting, certification, rationalization of workstations, etc., were all revealed.

Visitors were able to become acquainted with the experience of operation under conditions of full cost-accounting, self-finance, and self-support that has been accrued by such enterprises as Moscow's Machine Building Plant imeni S. Ordzhonikidze, the Moscow No. 1 Clock Plant, and the Moscow refrigeration machine building plant Kompressor.

A great deal of attention was paid to showing means for improving the system to manage production planning based on the use of modern computer technology in all stages. The section's exhibit reflected progressive brigade forms of organizing and stimulating labor. These methods were represented by a complex of scientific-methodological materials on introducing and developing the brigade form of labor organization and on the experience that has been accumulated relative to cost-accounting brigades and a collective contract in various sectors of the national economy.

UDC 65.012.6:025.4.036:658.516

Creation of Republicwide Automated Product Quality Data Bank

18610114 Moscow STANDARTY I KACHESTVO in Russian No 9, Sep 88 pp 30-32

[Article by V. V. Kishevich, head of the Quality and Standardization Department, BSSR Gosplan, and V. A. Knysh, deputy department head, Belorussian Scientific-Technical Information and Technical-Economic Research Scientific Research Institute, BSSR Gosplan]

[Text] The results obtained from quality control of the products manufactured in Belorussia confirm that about 70 percent of new types of production do not meet contemporary requirements. In particular, machine building production industries are noticeably lagging from the standpoint of their specific consumption of materials and fuel consumption, their reliability indicators, design, etc.

Analysis has shown that unsatisfactory work related to long-range assessment and forecasting of the technical level and quality of a product is one important reason why a new product with low technical and economic indicators is launched into production. Very frequently, the indicators of a perspective prototype are selected randomly without any analysis comparing the new product with the best domestic and foreign analogues and without making any allowance for the trends in the product's development and improvement. Often, products with low-level parameters are selected as analogues for comparison. This allows designers to adopt a formal approach to evaluating whether developments conform to the world level. To a large extent, this results from an insufficient mastery of modern information processing methods.

To correct the situation that has evolved, a republicwide system of information about products' technical level and quality has been created and is operating successfully. The system is an automated data retrieval system with an automated data bank. The BSSR Gosplan, Belorussian Republic Administration of the USSR State Bureau of Standards [Gosstandart], branch scientific research institutes and design offices, the BSSR Academy of Sciences, and the BSSR Ministry of Education were all involved in the work to create the system. The Belorussian Scientific-Technical Information and Technical-Economic Research Scientific Research Institute [BelNIINTI] of the republic's Gosplan was designated its head organization.

The republicwide system of technical information about products' technical level and quality (Figures 1 and 2) presents all administrative organs with the minimum necessary and sufficient information. The system is distinguished by virtue of the orderliness, precision, and reliability of its data, and its information is in a form that is convenient for all users to interpret.

Typical queries in the system are standardized, and the output information is issued in a cross section of the following computergrams: a catalogue of products of the branch's enterprises, a catalogue of an enterprise's products, a catalogue of analogous products, a catalogue of prototypes, quality indicators of the branch's products, quality indicators of an enterprise's products, prototypes' (analogues') quality indicators, the comparative characteristics of a product and its analogues, the results of the certification of an enterprise's products, and information about products' patent purity.

As of the end of December 1987, the system's data bank contained about 3,000 documents with information about domestic and foreign engineering prototypes, including more than a thousand documents related to the most important types of machine building products.

To ensure the continual actualization of the automated data bank and eliminate duplication of work by the BelNIINTI and the BSSR Regional Administration of the USSR Gosstandart, the two signed a bilateral agreement concerning distribution of their functional responsibilities. The functions of the Belorussian Republic Administration include formulating a store of charts on the technical level for certified production; organizing the receipt of information from the All-Union Technical Information, Classification, and Coding Scientific

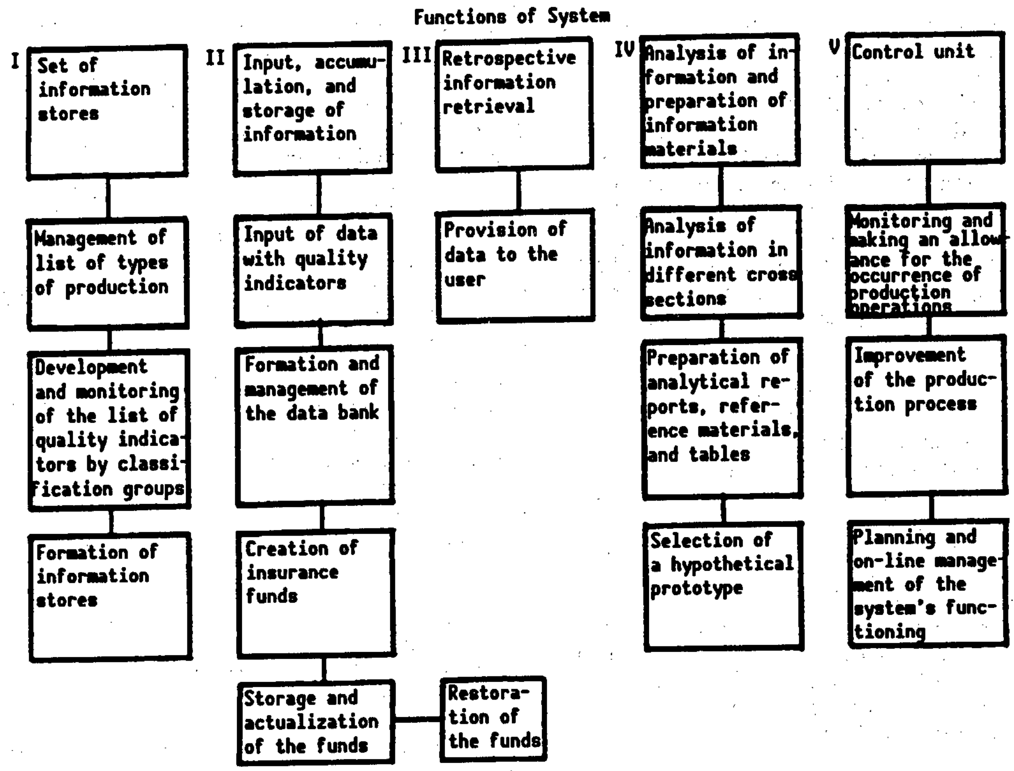


Figure 1. Internal Functional and Organizational Structure of the Republicwide System of Information About the Technical Level and Quality of the Most Important Types of Products

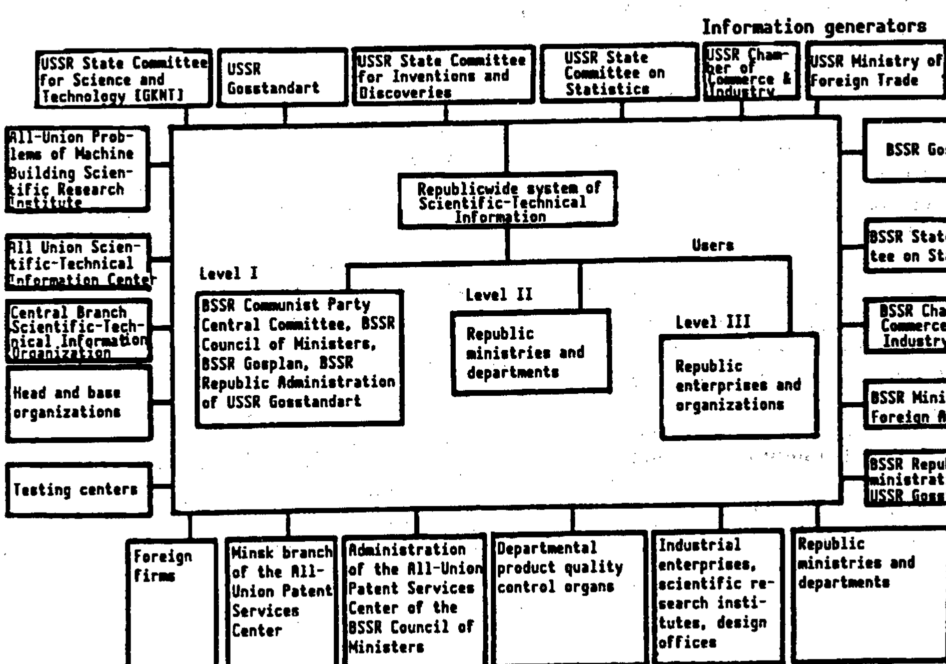


Figure 2. External Functional and Organizational Structure of the System of Information About Products' Technical Level and Quality

Research Institute about the OTT [not further identified] state standards, International Standards Organization [ISO] and CEMA standards, and the national standards of foreign countries; making quarterly presentations of information about the results of the state inspection and about certification of production relative to quality categories; and generalizing and transmitting the consolidated plan for certifying industrial production. The responsibilities of the BelNIINTI include making regular presentations of information about the technical and economic indicators of the best domestic and foreign prototypes with respect to the most important types of products produced in the republic.

The software for the automated data bank was developed at the Mathematics Institute of the BSSR Academy of Sciences by using an applications package for an automated multibranch interactive document and data system (ASPID-5) based on a YeS computer. Assembler and some specialized languages (a language to design mockups, etc.) were used as the programming languages. The system features an interactive operating mode and uses video terminals. In addition, the system gives the user the capability of previewing (with the help of the reference portion of the thesaurus and the video terminal screen) the contents of the document in which he is interested and, when necessary, including the necessary parameters in the output tablegram.

Unfortunately, the branch automated systems for information related to product quality that are currently functioning in the republic are based on automated data banks and support software, which creates definite problems in exchanging information.

These difficulties are, above all, the result of the fact that the documents containing input and output information are not standardized and their software is not universal. It is therefore very important that unified methodological and organizational management of the development of similar systems be provided.

It is especially important to note that the practical value of automated data banks arises from the presence and continued accumulation of reliable data about the technical and economic indicators of domestic and foreign prototypes of a specific (specified) product list. The republic's currently functioning data bank does not yet fully meet these requirements since it contains only limited information about the technical and economic indicators of domestic and foreign prototypes (analogues) for individual types of products. This makes conducting a comparative analysis difficult. Measures are therefore being taken to activate all types of work related to including the necessary information in the automated data bank.

At the current time, data about foreign prototypes is only collected manually by using the traditional sources (periodicals, materials from the Ministry of Foreign Trade and the Chamber of Commerce and Industry, foreign firms' prospectuses and catalogues, etc.) and materials obtained from the leading foreign firms, with which the BelNIINTI has been corresponding since the second half of 1986. The BelNIINTI sent more than 400 letters to different foreign firms producing analogous products and has received answers from about a quarter of them to date. In addition, the automated data bank contains information about international standards (ISO, International Electrical Engineering Commission [IEC], CEMA) and national standards of the capitalist countries.

Data from the automated data bank are widely used in preparing the annual report about the technical level and quality of the most important types of products and consumer goods manufactured in the BSSR. From a structural standpoint, the 1987 report consists of four sections: the general characteristics of the status of product quality, the launching of the production of new types of products produced by BSSR enterprises, methods of assessing and forecasting the technical level of products being manufactured (created), and the technical level and quality of the most important types of machine building products being manufactured. The report was sent to the republic's party and soviet organs as well as to the ministries and departments so that it could be analyzed and measures could be taken to increase the technical level of the most important types of products manufactured in the republic.

The following are necessary in order to further develop the automated data bank on products' technical level and quality:

- Accelerate the creation of union branch data banks about the technical level and quality of production with unified software because, without it, users will have a difficult time accessing and exchanging information on computer carriers;
- Develop and create a network of user centers based on modern technology (video terminals, intelligent terminals for transmitting data along telephone channels, and personal computers) so as to provide access to the union central branch and republicwide data banks;
- Specify an organization to head the country's development of modern software geared toward a data system about the technical level and quality of production;
- Develop a unified computer-oriented format for a chart on a product's technical level (GOST 2.116-84), which will make it possible to automate the process of gathering information about the technical and economic indicators of new types of products and selected analogues and input into an automated data bank information about the technical level and quality of production.

UDC 629.113.002

Current and Planned Products of USSR Bearing Industry Discussed

18610077 Moscow AVTOMOBILNAYA PROMYSHLENNOST in Russian No 7, Jul 88 pp 22-28

[Anonymous article: "Subsector for National Economy"; first 15 paragraphs are boldface AVTOMOBILNAYA PROMYSHLENNOST introduction]

[Text] Our domestic industry currently produces more than 20,000 different modifications and type sizes of bearings with diameters ranging from 0.5 mm to 3 m or more and masses ranging from fractions of a gram to 7 tons. In all, more than 1 billion units are produced annually.

Radial and radial-thrust bearings having different designs, radial roller bearings with short cylindrical rollers, and roller bearings with conical rollers are among the bearings that are produced for the agricultural, chemical, textile, construction and road machine building, and aircraft construction industries.

In view of the growing need for railway transport, the subsector has organized the manufacture of bearings with short cylindrical rollers whose rings are manufactured of steel having a controllable hardenability. Using this steel makes it possible to significantly increase the serviceability of these bearings when they are used in contrast climate zones under increased dynamic loads.

The subsector supplies radial-thrust and four-row and multirow bearings to the heavy machine building sectors. It supplies the automotive industry with an entire range of bearings for all types of automotive technology, including needle bearings for the cardan shafts of MAZ, ZIL, and KrAZ trucks and tractors. These bearings possess a high degree of operating reliability.

Bearing plants produce bearings to operate under special conditions: high-speed corrosion resistant bearings with separators made of polymer materials as well as self-lubricating, flexible heat-resistant bearings.

An analysis of current trends in the development of machine building and instrument making in our country shows that the national economy's need for rolling bearings may be satisfied in the 12th Five-Year-Plan not so much by increasing the volumes in which existing designs are being produced but more by increasing quality and sharply expanding the product list (particularly that of progressive types of bearings) as well as by changing the structure of manufacturing within their main design groups.

Retooling will accomplish one of the main tasks of the 12th Five-Year-Plan, i.e., ensuring the necessary output without increasing the number of workers. The principal direction here is wide-scale mechanization and automation of labor-intensive processes.

The further development and introduction of new production processes for manufacturing bearings is a very important direction of the work for the subsector during the five-year-plan. This includes semihot die forging on multiposition presses, uncoiling ball bearing rings, and using the powder metallurgy method to manufacture blanks and components.

Work to create flexible retoolable complexes and robotized production lines is receiving a great deal of attention. For example, about 120 robotized production complexes have already been introduced. Using them makes labor-intensive operations much simpler and frees workers from monotonous nonproductive labor.

Machine tool building proper is developing at a rapid pace to implement the extensive program of retooling in the bearing industry.

The directions for work to increase the quality of products manufactured have been precisely defined for the 12th Five-Year-Plan: improve the bearing designs that have been launched into series production by optimizing their geometry, use high-quality steels and alloys, and make extensive use of nonmetallic materials; develop new lubricants; and create fundamentally new and progressive bearing designs by using modern research and testing equipment and computer technology.

To increase the quality of the manufacture of such high-precision products as rolling bearings, a further improvement in inspection methods has been planned: equipment to automatically inspect and sort components, including bodies of revolution, has been developed, as has equipment to monitor the output parameters of assembled bearings. Measurement methods that had previously been considered methods exclusive to the laboratory are now finding wide-scale use. This includes the introduction of instruments to measure the shape of raceways and the inner rings of ball and roller bearings in their radial and axial cross sections, instruments to inspect the angular and linear dimensions of components and certify reference standards, and laser units permitting the microanalysis of an optical image of a bearing raceway as the ring rotates continuously, as well as special equipment to measure the level of bearings' vibrations.

A great deal of work to create new bearing designs and equipment to produce them is currently being conducted within the framework of the Organization for Cooperation in the Bearing Industry Among CEMA Member Countries. This is particularly the case in such directions as creating new and improving existing bearing designs; developing high-efficiency production processes for manufacturing bearing components and assembling them; and creating progressive types of equipment, inspection hardware, and new, high-quality materials.

The subsector's plants are exporting bearings to 70 countries throughout the world, and even the volumes of exports to such countries with highly developed industry as England, Italy, France, the FRG, and Switzerland are constantly increasing.

The best prototypes of domestic bearings intended for different purposes as well as equipment for producing them have been exhibited. We will examine some of these.

General-purpose bearings

Ball bearings for a linear movement, i.e., 6-510820L1S2 for the press mechanisms of automatic hydraulic presses and 400801L and 400807L for automated lines for assembling speakers, provide a high operating durability, and their mechanisms are reliable and easy to operate. They may be used in the subassemblies of machines that make a reciprocating motion instead of slide bearings made of nonferrous metals.

Their key technical data are presented in Table 1.

Table 1

Bearing Designator	Overall Dimensions, mm			Mass, kg
	d	D	B	
6-510820L1S2	100	150	175	11
400801L	12	23	32	0.053
400807L	35	52	70	0.405

GPZ-12 bearings are also manufactured.

I2503 split radial-thrust ball bearings (overall dimensions, 600x700x50/100 mm; mass, 57.4 kg) are intended for use in the subassemblies of production equipment. They give moving systems a high operating reliability, light weight, and a smooth movement for subassemblies.

Their distinguishing feature is their splitting of the rings in the axial plane, which makes it possible to assemble subassemblies quickly without disassembling the machine. The bearings may be used as supports for subassemblies receiving combined loads. They are manufactured by the production association GPZ-1. These and other bearings have been developed by specialists from the All-Union Bearing Industry Scientific Research and Planning and Design Institute.

The bearings 202ASZ through 210ASZ and 302ASZ through 310ASZ, which contain tough lubricating aggregate AFZ-3, are radial ball bearings with a snake separator. Their interjoint space is filled with a mixture based on AFZ graphite, which consequently hardens. Bearings with the filler AFZ-3 are recommended for use in the subassemblies of machines with a period temperature effect of up to 570K (+300°C); rotation frequencies characterized by a velocity parameter davn of less than or equal to 6;000 mm·min^{-1}; maximum contact stresses on the inner ring of up to 2 GPa; an absence of dynamic, impact, and vibration loads; and requirements related to rotation precision.

Transport systems and conveyer lines, annealing and sintering carriages, drying and steaming cars for different branches of industry, and many other machines and mechanisms whose operating modes satisfy the aforementioned requirements are the most feasible places in which to use bearings operating with AFZ-3 filler. The insignificant gaps between the rings and filler make it possible to use bearings designed in this manner in a dusty environment without any additional servicing (field tests have shown that they do not lose their durability over the course of 2 to 3 years, or even longer in some cases).

Specialists from the All-Union Bearing Industry Scientific Research and Planning and Design Institute have developed a method that makes it possible, on the one hand, to make extensive use of the tough lubricant AFZ-3 and save on traditional, more expensive lubricants and, on the other hand, to solve many of the practical problems entailed in using bearings under specific operating conditions.

Bearings with the tough lubricating aggregate are currently being series produced in accordance with the requirements of specification TU 37.006.143-85.

When assembling, disassembling, and operating these bearings it is necessary to use the method of pressing by using hydraulic or other attachments that eliminate impacts capable of damaging the filler. They are not recommended for use in subassemblies subjected to the effect of dynamic, impact, and vibration loads. Since the material AFZ-3 does not protect a bearing against moisture and the appearance of corrosion on the rings and balls, these bearings are pretested in subassemblies where moisture may occur.

The bearings were developed by the scientific production association VNIPP and the All-Union Electronic Products Scientific Research Institute, and they are manufactured by GPZ-13 and GPZ-21.

The bearing with vibration-absorbing and vibration-damping components is designed to operate under increased vibrations. Its design is distinguished by the presence of vibration-damping rings onto which a bushing made of high-precision vibration-absorbing porous mesh material has been pressed. These rings make it possible to reduce the log level of the bearing node's vibration velocity by 8 to 15 dB.

Vibration-absorbing components may be used in bearings belonging to all design groups, with the exception of thrust and special combined bearings.

The developers are the scientific production association VNIPP and the Moscow Higher Technical School imeni N. E. Bauman, and the manufacturer is the scientific production association VNIPP.

Bearings with an increased load-carrying capacity, for example, bearings 209A, 211A, 310A, 50208A, and 50209A, are single-row radial ball bearings that are distinguished from the ordinary design by the optimized ratios of the radii of the raceways of their rings and balls, which increase their dynamic load-carrying capacity by 20 to 39 percent and increase their operating durability more than twofold.

The bearings 32310K2M, 42310K2M, 7308A, 7315A, 7318A, 7511A, 7515A, 7516A, 7517A, and 2007913A are single-row bearings with short cylindrical and conical rollers. They are larger and have more rollers than ordinary rollers, thanks to which their dynamic load-carrying capacity is generally 20 percent higher and their durability is twice as great.

The bearings 210AK, 307AK, 310AK, 408AK, 409AK, and 50408AK are single-row radial ball bearings with an increased load-carrying capacity and with an optimal ratio of the raceways of their rings balls. The rims of their rings are shorter, with their axial load-carrying capacity amounting to 0.07 their dynamic load-carrying capacity. Optimizing the diameters of the rings' rims has reduced the amount of metal used in the bearings by 7 percent on average and has reduced the labor intensity of machining the rings, the wear to the cutting tool, and the need for a cutting tool. It has also improved the conditions of assembling a bearing.

The bearings have been developed by the scientific production association VNIPP and are manufactured by the production associations GPZ-1, GPZ-9, GPZ-15, GPZ-18, GPZ-20, and GPZ-28.

Bearings for the aviation industry

In aviation technology products, bearings operate under high and low temperatures, under significant loads, and at high rotation frequencies. Nevertheless, all of the types of bearings manufactured provide a guaranteed operating life under all climate conditions and guarantee the operating reliability of all systems.

Thus, single-row radial bearings with short cylindrical rollers (55-272734R1 and 55-272744R2 are special bearings with an outer ring that has grooves under the packing ring of the oil damper, and 6-1672832R5U and A672126R1 have an expanded inner ring) operate reliably in high-rotation subassemblies at a temperature up to 670 K (+400°C). Single-row radial-thrust ball bearings with a split inner ring (5-176126R5V with a flange on the outer ring; 5-1126934R2, 85-1126928R1, and 85-1126956R1 with a groove for disassembly; 5-1126926R2 with a steel separator; and A176130R3 and A176128R2) are capable of accepting combined loads at a temperature up to 620 K (+350°C) and high rotation frequencies. Also capable of accepting the same loads are 34-100D high-rotation ball bearings and 4-36101D single-row radial-thrust bearings (they are used in high-speed subassemblies with a rotation frequency up to 90,000 min^{-1}). Heat-resistant and corrosion resistant bearings (70-302YaV, a spherical bearing, and 76-732302YaV, a roller bearing) are intended for operation without lubrication in subassemblies with a rocking motion at a temperature up to 970K (+700°C). The bearings 7754M, 7866A, and 6-3007928KhM are conical roller bearings with an increased load-carrying capacity and have thin-walled rings and a stamped separator.

The single-row spherical radial ball bearings 881067YuUS21, 881068YuUS21, and 881700YuUS21 with two membrane seals (separatorless) may operate under any climate conditions at a temperature of 210 to 370 K (from minus 60 to plus 100°C). Doubled radial-thrust bearings (5-466406E), single-row radial bearings (45-206E1), and single-row radial roller bearings (5-292073E, 5-502302E1, and 5-2308E) made of the new heat-resistant steel ShKh15Sm-Sh have massive bronze separators with a silver coating. They guarantee that products will operate reliably at a temperature up to 470 K (+200°C).

The hinged, self-lubricating bearings ShNR6Yu, ShN8Yu, ShN10Yu, ShN12Yu, ShN15Yu, ShN17Yu, ShN20Yu, ShN25Yu, ShN30Yu, ShN35Yu, ShN40Yu, ShN45Yu, ShN50Yu, and ShN55Yu, which have internal diameters between 6 and 55 mm, operate in movable joints with rocking motions at a temperature up to 450 K (+180°C) without additional lubrication over the course of their service life.

The bearings ShLT15YuT, ShLT25YuT, ShLT30YuT, ShLT35YuT, ShLT55YuT, and ShLT80YuT are hinged, self-lubricating bearings with a broken outer ring and fabric antifriction gasket. They are intended for operation in movable joints with a rocking motion and are capable of operating at temperatures between 210 and 390 K (from minus 60 to plus 120°C) without any additional lubrication over the entire course of their service life, and they have a small displacement moment. The bearings 914800K, 884705Yu1, 914803K(Yu2), and 914804K1(Yu2), are single- and double-row needle bearings that have a thickened outer ring forming an outer ring [sic] with a sphere for self-mounting when it is rolled along a rail.

They were developed by the scientific production association VNIPP and are manufactured by the scientific production association VNIPP and the GPZ-1, GPZ-3, GPZ-4, GPZ-9, and GPZ-15 production associations.

Bearings for heavy and transport machine building

Single-row radial bearings manufactured in accordance with special specifications are intended to accept a radial (axial) load in the axle assemblies of freight and passenger cars and electric trains. Their balls have increased dimensions, and their rings are made from ShKh4 steel with a controlled hardenability, which makes it possible to increase the assemblies' durability, increase the cars' run, and reduce expenses for plant and running repair of the railroad rolling stock.

The bearings 12872K and 12872Z are multirow, separatorless radial-thrust ball bearings that are capable of operating in a clay solution medium under high impact or vibration loads. They are used in turbodrill supports instead of rubber and metal slide bearings. Thanks to these bearings, it has been possible to increase technical and economic indicators during the turbine method of drilling oil and gas wells.

The original design of the special ball bearing support 106901K (a separatorless four-row mixed-type bearing) is used in a small-scale screw tamping motor.

The single-thrust roller bearing 889752Kh1 with short cylindrical rollers is used in the main support of the swivels of UV-250 drilling rigs. It has an increased load-carrying capacity and high speed, and it permits a 1.5-fold increase in support strength.

The radial-thrust ball bearings 1687/770Kh, 1688/770Kh, 1688/1060Kh, and 1687/1060Kh with plane massive separators and a contact angle of 55 degrees instead of 45 degrees are used primarily in the auxiliary bearings of R700 and R950 rotors.

They are manufactured by the production associations GPZ-1, GPZ-9, and GPZ-11.

Four-row radial bearings with short cylindrical rollers are mounted in the supports of the workers of cold-rolling sheet-rolling mills and pipe-rolling units. Special multirow precision radial bearings with short rollers and a thickened outer ring are used in the subassemblies of the bearing rollers of multiroller rolling mills. Four-row conical roller bearings with an increased load-carrying capacity are used in the supports of the workers of finishing hot-rolling mills. Special separatorless thrust ball bearings that are completely filled with ball bearings are used in hinged subassemblies of the universal spindles of pipe-rolling mills. They make it possible to achieve two- to fourfold increases in the bearings' operating stability, the rollers' strength, and the rolling precision as well as reduce the consumption of bearings.

They are manufactured by the production associations GPZ-1, GPZ-9, and GPZ-20.

All of the aforementioned bearings have been developed at the scientific production association VNIPP. Their technical data are presented in Table 2.

Table 2

Bearing Designator	Overall Dimensions, mm			Mass, kg
	d	D	B	
For Railway Transport				
30-42726L4M	130	250	80	18.9
30-32726L1M	130	250	80	18.2
80-176226L	130	230	40	8
For Metallurgical Equipment				
4427/750KhK	750	1,090	775	2,562
77880M	400	540	280	175
2032172LM	360	540	106	92.7
5-462826U	130	300	150	62.1
5-462836Kh1	180	406	216/2	162
1077792KhM	460	760	520	1,061
188822	110	190	40	4.4
For Drilling Technology				
128721K	105	165	505.5	60.4
128723	115	205	570	88.8
106901K	14	45	75.5/185	1.1
889752Kh1	260	540	132	172.7
1687/770Kh	770	1,000	150	292
1688/770Kh	770	900	90	92.5
1688/1060Kh	1,060	1,180	90	119
1687/1060Kh	1,060	1,280	150	338

Bearings for machine tool building

Two-row bearings with short cylindrical rollers are intended to accept radial loads. They provide a high carrying capacity, radial rigidity, high speed, and precision of rotation in the spindles of metal-cutting machines, for example. Bearings whose designations contain the letter "K" have grooves on their outer rings and holds for feeding lubricant into zone in which the rollers come into contact with the raceways. Those with the letter "E" have separate plastic separators that improve the kinematics of the bearings' rotation. Those with "K1" have separate brass separators that make it possible to increase the bearings' speed of passage. They are manufactured by the production association GPZ-1.

Doubled unitized radial-thrust ball bearings that accept combined loads are used in the thrusts of the high-speed spindles of precision machine tools. They satisfy increased requirements for rigidity, precision of rotation, and speed. They are manufactured at the GPZ-3 and GPZ-4.

Single- and double-row radial-thrust bearings with conical rollers with increased radial rigidity are used in the spindle supports of numeric control machine tools. They experience combined loads. They are manufactured at the GPZ-15.

The double combined thrust bearing 2-509740 and the radial bearing with short cylindrical rollers may accept combined loads in the faceplate supports of the turntables of numeric control machine tools. The bearing unit 20.012SB consists of three rows of rollers, two of which are located in a crossed fashion. It is intended for installation in the support of the drive for a circular milling cutter of a machine tool for machining crankshafts. The two-row radial-thrust ball bearing 4-178832L1, which has a contact angle of 60 degrees, is used in lathe spindle supports. It is manufactured in accordance with class 4 precision.

All of these bearings (their technical data are presented in Table 3) are manufactured by the GPZ-1 and GPZ-23.

Table 3

Bearing Designator	Overall Dimensions, mm			Mass, kg
	d	D	B	
4-3182111Ye	55	90	26	0.62
2-3182116K	80	125	34	1.51
4-3182116Ye	80	125	34	1.3
2-3182120K	100	150	37	2.2
2-3182118K	90	140	37	2.03
2-3182112K	60	95	26	0.69
4-3182128K	140	210	53	6.06
4-3182132K1	160	240	60	8.4
4-3182136K	180	280	74	16.9
4-1436900K	10	22	12	0.021
2-1436908K	40	62	24	0.242
12-246112U12	60	95	54	1.26
22-246116KU12	80	125	66	2.5
22-246120KU12	100	150	72	4.38
22-1246918KU12	90	125	54	1.85
22-1246932KU12	160	220	84	8.68
2-17819L	95	152	68.6	3.505
2-17724L	120	180	88.65	6.29
2-697724L	120	180	96.8	8.15
22-697828L	140	190	86	5.94
2-509740	200	300	45	9.63
20.012.SB	800	1,480	228	1,300
4-178832L1	160	240	96	12.5

Bearings for the electrical engineering industry

The list of products of the electrical engineering industry in which rolling bearings are used is very extensive. It ranges from miniature electric motors for household products to complex equipment for the drive system of walking excavators and nuclear power plants. But the entire product range shares one common property. All these products need bearings with rigidly controlled indicators: vibration level, antitorque moment, operating life, and metal intensity. The bearings produced by the subsector meet this requirement.

Thus, the bearings 75-180205K1S9Sh6 and 75-180306AKS9Sh6 are single-row radial ball bearings that have a bilateral seal and require a single application of lubricant. They operate reliably in the bearings of those electric motors belonging to the unified series AI. The bearings 74-180602Ye3S22Sh8, 74-180604YeZS22Sh8, and 74-180605YeZS22Sh8 are single-row radial ball bearings having a bilateral seal and requiring a one-time application of lubricant. The bearings 74-309YeSh8 and 74-311YeSh8 are single-row radial ball bearings that are used in electrical machines with increased requirements from the standpoint of vibroacoustic characteristics. The bearings 75-180500YeZT2S15, 75-180501Ye42S15, and 75-180502Ye4T2S15 are single-row radial ball bearings. They have a bilateral Phenylone seal, and they require a constant application of material. They are highly reliable bearings for aviation electrical aggregates operating under conditions of increased temperatures and having an increased service life.

Table 4 presents technical data on all of the aforementioned bearings.

Table 4

Bearing Designator	Overall Dimensions, mm			Mass, kg
	d	D	B	
75-180205K1S9Sh6V	25	52	15	0.120
75-180306AKS9Sh6V	30	72	19	0.344
74-180602YeZS22Sh8	15	42	17	0.109
74-1080604YeZS22Sh8	20	52	21	0.208
74-180605YeZS22Sh8	25	62	24	0.325
74-309-YeSh8	45	100	25	0.819
74-311YeSh8	55	120	29	1.290
75-180500YeZT2S15	10	30	14	0.050
75-180501Ye4T2S15	12	32	14	0.050
75-180502Ye4T2S15	15	35	14	0.060

They were developed by the scientific production association VNIPP and are manufactured by the GPZ-23 and GPZ-4.

Bearings for power engineering and chemical machine building and cryogenic technology

The single-row heat-resistant self-lubricating radial ball bearing 36-105R1 is intended for operation at high working temperatures without any lubricant. The bearings 26-I4918T, 26-907YuT, 26-I5983T, and 6-818YuT are special corrosion-resistant flexible ball bearings. They are used in the reducing gears of the strain-wave drives (the latters' rings have a small cross section and can operate with a strain arising during rotation).

The high-speed corrosion-resistant ball bearings with silver-coated rings and a separator made from polymer materials, i.e., 35-I5957, 35-276214Yu4, 35-I5982, 35-208Yu5, and 35-209Yu12T (self-lubricating corrosion-resistant ball bearings) operate without any external feed of lubricant and under deep vacuum conditions. The special eccentric hinged bearing 9ShE110Yu makes it possible to accomplish self-centering when combining the massive structures of the mechanisms used in the power engineering industry. The special single-row corrosion-resistant radial ball bearings I5958 and I5906, which have lightweight designs and a small free cross-sectional area, are used in the assemblies of machines having limited overall dimensions and masses. The corrosion-resistant bearings 36-210Yu13, 36-I6939, 35-I49321T, 46-I6953, and 36-860706Yu are used in the assemblies and machines and mechanisms operating in water-steam and acid-alkali media. The hinged bearings ShLT6YuT, ShLT15YuT, ShLT25YuT, ShLT40YuT, and ShLT75YuT, which have a fabric antifriction gasket, are used in assemblies with a rocking motion under conditions of inadequate lubrication. The special thrust ball bearing 6-358752Yu1 with a split inner ring, small active cross-sectional area, and a flange on the outer ring for fastening in an assembly is used in the Rokus medical unit.

Table 5 presents technical data on these bearings.

Table 5

Bearing Designator	Overall Dimensions, mm			Mass, kg
	d	D	B	
36-105R1	25	47	12	0.081
26-I5983T	19	26	5	0.010
26-I4918T	80	100	18	0.163
26-907YuT	36	47.5	8	0.027
6-818YuT	120	160	24	0.130
35-I5957	30	62	16	0.233
35-I5982	105	190	36	3.850
35-276214Yu4	70	125	24	1.200
35-208Yu5	40	80	18	0.378
35-209Yu4	45	85	19	0.346
35-I5968	9	26	8	0.010
35-I6961	10	30	9	0.049
35-204Yu10T	20	47	14	0.129
35-204Yu12T	30	62	16	0.228
6-358752Yu1	260	356	15	4.9
9ShE110Yu	110	150	50	2.7
I5958	235.5	260.9	17	0.484
I5906	200	240	16	1.3
36-860706Yu	30	72	16/18	0.4
36-210Yu13	50	90	20	0.68
36-I6939	20	55	18/14	0.2
35-I4932T	17	40	12	0.072
46-I6953	45	85	19	0.5
ShLT6YuT	6	14	4/6	0.005
ShLT15YuT	15	28	8/12	0.040
ShLT25YuT	25	42	16/20	0.110
ShLT40YuT	40	62	22/28	0.330
ShLT75YuT	75	105	41/52	1.300

They were developed by the scientific production association VNIPP and manufactured by the production associations GPZ-1, GPZ-2, GPZ-4, and GPZ-3.

Bearings for instruments

The radial-thrust ball bearings 4-186724YuT, 4-186728YuT, and 4-9838130YuT, which have a four-point contact with flanged rings, are used in the precision assemblies of instruments. They are manufactured in accordance with precision class 4 (the rings and balls are made of corrosion-resistant steel and the separator is made of the ASP-plastic Esteran-51). They reduce products' mass, make their assembly easier, and increase their precision and rigidity. The radial-thrust ball bearing 4-708054 is used in the precision assemblies of instruments. It is also manufactured in accordance with precision class 4 (the rings and balls are made of ShKh15 steel and the separators are brass).

Bearings with a reduced torque moment are used to support the axes of the gimbal mounts in gyroscopes. The small, single-row radial ball bearings 1000091Ya, 1000092YuZ, and 840154Yu4T operate under conditions of the effect of magnetic and electromagnetic fields, special media (100091Ya and 1000092YuZ), and a relative moisture of the surrounding environment up to 98 percent (840154Yu4T). They have stamped snake separators.

All these bearings (Table 6) were developed at the scientific production association VNIPP, and they are manufactured by the GPZ-22, GPZ-23, GPZ-4, and other plants.

Table 6

Bearing Designator	Overall Dimensions, mm			Mass, kg
	d	D/D_F	B/B_F	
Special Bearings				
4-708054	5	13/30	13.2	0.020
4-186724YuT	120	145/156	11.5	0.273
4-186728YuT	140	180	16.5	1.1
4-9838130YuT	150	180	20.7	0.6
With Reduced Frictional Torque				
4-46109Yu	45	75	16	-
4-7046910Yu	50	72	8	-
4-7076824Yu2	120	150	10	-
4-7836638Yu	190	225/235	14/3	-
4-7000808Yu2	40	52	4	-
Small-Sized				
1000091Ya	1	4	1.6	0.00012
1000092Yu3	2	6	2.3	0.00031
840154Yu4T	1.5	4	1.7	0.00011

Bearings for agricultural machine building

New bearing designs (Table 7) are being manufactured for subassemblies used in agricultural engineering, including the high-productivity combines belonging to the Don family. Thanks to these bearings, the metal intensity of the bearing assemblies has been reduced, their durability has been increased, and the time required to perform maintenance on the combines has been reduced (particularly because of new seal designs that reliably protect the bearings' working area from contaminants and moisture). The first bearings with a spherical outer surface to be used in actual practice were those that were designed and manufactured with lock pins (to keep them from turning in the casing of a product's assembly).

Series 780000 bearings are fastened to a shaft by using an eccentric ring that is manufactured together with them, whereas bearings belonging to the series 168000 are fastened by using an adapter sleeve.

Table 7

Bearing Designator	Overall Dimensions, mm			Mass, kg
	d	D	B	
Single-Row Radial Spherical Ball Bearings				
21204	20	47	14	0.100
21207	35	72	17	0.265
21306	80	72	19	0.320
21308	40	90	23	0.600
Single-Row Radial Ball Bearings With a Spherical Outer Surface				
580306K7S17	30	72	19	0.342
780716KS17	80	150	39/71	3.600
168205NK10S27	25	62	18	0.344
1680206NK10S27	30	72	20	0.478

Developer: VNIPP Production Association; manufacturers, the GPZ-4, GPZ-11, GPZ-14, GPZ-8, and GPZ-23 production associations.

UDC 658.155:621

Improving Mechanism of Generating Full Cost-Accounting Income for Enterprises Under Self-Finance

18610063a Moscow VESTNIK MASHINOSTROYENIYA in Russian No 6, Jun 88 pp 68-71

[Article by V. A. Kotlov, candidate of technical sciences]

[Text] The current scales of production and the exhaustion of most the possibilities of the extensive route of development have objectively predetermined the need to comprehensively intensify industrial activity on the basis of scientific-progress, structural restructuring, the introduction of efficient forms of management, and organization and stimulation of economic operation. One such form is full cost-accounting and self-finance.

Beginning in 1988, in accordance with the USSR Law Governing the State Enterprise (Association), the principles of full cost-accounting and self-finance have been disseminated to all enterprises and associations in the machine building complex. The basic economic units should operate profitably; ensure scientific-technical, production, and social development through earned resources; be fully accountable for the results of their activity; and fulfill their obligations to suppliers and customers and to the budget and the banks.

The collective's full cost-accounting income and borrowed resources in the form of bank credits are the sole sources of wages and the resources required to sustain and improve production and solve social problems. In this context, the economic role of cost-accounting income increases objectively.

It may be generated by two methods: by the normative distribution of profit and by the normative distribution of the income obtained after compensation from the gains resulting from the realization of the physical input from the production of a product or performance of services, which is sometimes called estimated income. In any case, the collective's full cost-accounting income is the sum of the wage fund and the development fund.

The wage fund accounts for the major portion of the wages in the case of the first form of full cost-accounting. When enterprises made the transition to the new management conditions, the base-increase method became the leading method for determining wages. According to this method, a wage is formulated by proceeding from its base value and the sum of the increase (decrease) in the fund as calculated relative to the norm for each percentage point of the growth (decrease) in the volume of production based on the indicator assumed for calculating labor productivity.

The base fund plays a decisive role in counting up the planned amount of the wage since the increase portion seldom exceeds 3 to 10 percent of its value. The base fund may be raised on account of an increased number of workers or a reduction in performance standards. It does not always reflect consumers' estimate of product quality or the updating of the product being manufactured. In other words, the mechanism of forming the base wage fund is in many respects subjective. Increases in such a base reproduce all of its flaws into the long-range future, reinforcing the inequality of production units that has evolved as a result of violations of the principles of wages based on labor that occur during the start-up period.

The differences in the economic positions of enterprises and associations are intensified even more because of a correction of the base fund for the rates at which labor productivity is increased, a situation that is aggravated by the absence of any allowance for the progressiveness and intensity of wage norms. The main portion of the wage fund is therefore reduced for the very economic units that, before the transition to self-finance, used practically all of their resources for increasing production and do not have the capability of increasing their production at the same paces.

In a number of ministries, wage fund increment norms are identical for all subdepartmental enterprises. The norms do not make any allowance for the level to which the enterprises use their resources, the status of labor standardization, or the structure of the factors related to an increase in labor's productivity. Furthermore, increment norms exert a weak stimulatory effect on labor productivity. Thus, calculations based on one Moscow enterprise show that when the growth rate of production output is increased 1.7-fold versus the base year the additional portion of the wage fund will amount to only 31.3 percent of its size, as specified for this increment by count-up. When the growth rate of production output is reduced 5.2-fold, on the other hand, that portion of the wage fund that changes is reduced by 30.6 percent as compared with that computed by count-up.

In summary, the wage fund is little related with the end results of the activity of the labor collective. Essentially, it reinforces expenditure-oriented management methods, which contradicts the deep meaning of self-finance. The expenditure orientation [zatratnost] of this method is particularly evident in the absence of any connection between wages and savings in reified labor. Indeed, this is currently one of the main problems. It reflects the essence of intensification. According to calculations, a 1 percent reduction in the consumption of materials and power provides a more than fivefold return to the national economy, whereas a 1 percent increase in the use of fixed capital has an impact eightfold greater than the same savings in wages.

The base-increase method of determining the wage fund is not flexible enough in relation to changing productivity conditions and changing paces of scientific-technical progress. The base wage fund is geared toward output under existing production conditions for a fixed range of products. Updating production changes the wage capacity of the production program. Cooperative relationships have an analogous effect. Expanding the scales of cooperation creates an unearned wage fund, whereas restricting cooperation creates a shortage of resources for labor wages.

Making wages a direct function of the end results of labor emerges as a powerful economic stimulus of economic progress. This dependence must, however, be established in such a way that the size of the wage fund is determined solely by current results but not by past results. Methods used to formulate wage funds must also make an allowance for the specifics of the branch in question, and advantages must be created for those enterprises that have achieved the highest efficiency. It is also necessary to gear wages more toward accelerating scientific-technical progress and increasing product quality.

In our view, the principle of generating resources for wages proceeding from a fixed structure of pure production is in full conformity with these requirements. Under conditions of the free realization of trade and monetary relations, pure production becomes the equivalent of the newly created cost. For this reason, the objectivity of a cost estimate of expended human labor that is made by using the method increases sharply.

The essence of this principle is that a specified (normative) correlation between profit and wage as a component of pure production is established by directive for each machine building branch or type of production for the planning period. The wage norm may be specified either as a percentage of the entire pure production or as a percentage of profit. The latter is preferable since, in the case of the first form of cost accounting, profit becomes enterprises' most important economic activity indicator and, as practice has shown, it is calculated first. By changing the percentage of wages in pure production it is possible to establish it at different levels for branches and types of production and thereby regulate branch proportions and development priorities.

When the principle of a fixed structure of pure production is used, the size of the labor collective's wage fund is determined not only by the quantity and quality of products manufactured but also, and this is very important, by production costs. When this is the case, the size of the wage fund is only limited by the established proportion between wages and profit. Therefore, when wages are increased, it is first necessary to have an equivalent increase in profit, which creates the objective prerequisites for increasing the efficiency of production.

In this case, changing the consumption of physical resources and the level to which fixed capital is used will either increase or decrease the wage fund. To some extent, this is being done now. The existing policies on paying out rewards permit the use of up to 50 percent of the cost of materials saved and up to 75 percent of the cost of conserved fuel and power resources. For individual types of energy resources, the reward may be raised to 95 percent of the cost of the savings.

As of yet, however, resource conservation stimuli have only a weak effect. At the Gorkiy Motor Vehicle Plant, the reward per ton of steel rolled stock saved (a cost savings of 150 to 170 rubles) comes to only 20 rubles. Only 8 percent of the cost of the amount of heat and electric power actually saved at a plant producing electric welding equipment (in the Lithuanian SSR) in 1987 was directed toward stimulating their conservation. Establishing a direct dependence between the wage fund and amount of production resources consumed under these conditions would make the process of resource conservation natural.

Maintaining the established proportion between profit and the wage fund means an automatic distribution of the income that arises. For example, given a ration of 45 percent to 55 percent, 45 kopecks of each ruble's worth of resources economized will be directed to the wage fund, and the remaining 55 kopecks will go to the budget, to the branch, to developing the collectives social sphere, and to improving production.

In the case of the first form of full cost-accounting, the profit remaining at the disposal of the enterprises and associations is another part of their full cost-accounting income. To a significant degree, its size depends on the norms for distributing pure income between the labor collectives, the state budget, and the ministries.

At the present time, production units transfer a portion of their profit to the budget in the form of payments for capital and profit withholding. In a number of ministries, the wage norm for fixed and working capital is established as a percentage of their cost and as a function of production profitability. Thus, in the Ministry of Chemical Machine Building, when enterprises have a profitability of 7.8 percent, they transfer a portion of the profit equal to 2 percent of the cost of the assets to the budget. At a profitability of 61 percent or higher, they transfer 12 percent. Profit withholdings to the budget are made as percentages of profit size, as a function of the profitability of production, as well as in accordance with incremental norms. For example, in the specified ministry, profit withholdings to the budget amount to 5 percent at a profitability of up to 7.7 percent and 40 percent at a profitability of 61 percent or higher.

This type of progressive taxation directly ties the state of the budget to the results of enterprises' and associations' utilization of production efforts. It moreover has a pronounced negative effect on increasing production efficiency. In particular, the portion of profit left to the economic unit decreases as the level of resource utilization increases. This means that, given identical amounts of production resources, the enterprise with the lower level of economic operations loses less profit. If a subdepartment operates at a lost or has a profitability of less than 7.8 percent, its capital is essentially free of charge.

On the other hand, highly organized services and enterprises using six times more resources may have identical withholdings from their profit. For example, in 1987 the Ruzkhimmash Plant used 3.1-fold more fixed and working capital than did the Bessonovskiy Compressor Plant. However its payment for capital was only 17.8 percent higher. A similar inversely proportional dependence of income on the level of work and the absence of any real connection between payments for capital and the cost of the capital used cause doubts as to whether such norms can play their required role as a stimulus for increasing production efficiency. In this context it would be advisable to view payments for capital solely as a form of gratis return of a portion of the national wealth to enterprises that have been singled out.

To a large extent, production profitability is determined by the level to which production is organized. Taxing profit as a function of this level of organization equalizes the amounts of subdepartments' pure income that is left over for the formation of intraoperation capital. According to this scheme, those economic units with the least production efficiency receive the greatest benefit, whereas those enterprises that are operating most successfully have the greatest hardship with respect to supporting the budget. Thus, in 1987 the amount withheld from the profit of the aforementioned plant Ruzkhimmash, which spent 19.4 percent more per ruble of consumer goods produced than did the Bessonovskiy Compressor Plant, was almost half that withheld from the latter's profit. In a number of machine building ministries, there is no withholding from low-profit production, nor is there any participation in the formation of state savings and consumption funds.

Progressive taxation of profit may thus, in principle, reduce collectives' interests in making more efficient use of production resources. Thus, calculations based on the scale of the Ministry of Chemical Machine Building show that, give an unchanged production volume, a 1.5-fold reduction in costs (the maximum limit of the scale) only provides a 3.3-fold increase in the amount of profit left to the enterprise whereas it provides a nearly 42-fold increase in withholding to the budget.

In the case of price formation geared toward expenditure of resources, profitability indicators cannot fully characterize production efficiency. At the Kharkov Turbine Plant, for example, one of its turbines for AES turned out to be highly profitable according to the established price even though the coefficient of the metal used in producing the turbine did not exceed 0.3 whereas the plant's price plan generally stipulated that this coefficient be between the level of 0.15 to 0.2. Thus, profitability indicators are little connected with the level of resource consumption. Often these indicators are raised by using resources wastefully. Therefore, when used as norming factors, production and product profitability only make it possible to regulate enterprises' incomes. They do not make it possible to regulate society's costs to create use values.

What is needed is a transition to norms that would make it really possible to control expenditures and their results by increasing enterprises' incomes as production efficiency is increased, thus eliminating the possibility of equalizing management conditions and at the same time ensuring equally intense requirements for the use of production resources. In this context it seems advisable to use planned and actual resource expenditures as the basis for determining norms. For example, payments for capital should be established as percentages of their cost with no allowance for production profitability. Norms should be established by central economic departments for each branch and type of production and with an allowance for regional differences.

The amount of withholdings from profit to the budget should be specified as a percentage of an enterprise's expenditure of reified labor—physical resources and amortization. The costs of all production resources will thus be regulated, which is an especially important task for our economy. Tax for actual expenditures of reified labor is a stable source of income into the budget, the value of which is easily verified. In addition, it frees the mechanism of stimulating economic operation from the effect of price formation for the end product.

Implementation of the new management methods is impossible unless close economic ties between enterprises and ministries are established. However, these relationships are presently one-sided. Enterprises transfer a portion of their profit to the branch for the formation of centralized funds and reserves. The apparatus of the ministry uses this amount at its own discretion. It may provide its own required wage and bonus funds. As a result, the link between the incomes of the administrative unit and the efficiency of its activity is broken. Moreover, there is a danger that the ministry's apparatus will make up for damage from its own poor operation at the expense of profit earned by the enterprises, without reducing its own income.

One way of resolving this contradiction may be to separate the norm for profit withheld for the ministry into two autonomous norms, each of which is established as a percentage of profit. The first norm would address withholdings for the branch's centralized funds and reserves. They are the collective property of the subdepartmental enterprises and associations. The directions in which they are used should thus be determined jointly by the administrative apparatus and the USSR Council of Ministers, whose creation has been stipulated by the policies for radically restructuring administration of the economy.

In accordance with the second norm, a portion of the profit earned by the economic units must be withheld for the fund of the central ministry apparatus, which is intended for wages, bonuses, improvement of social and living conditions for personnel, and other miscellaneous expenses related with administrative activity. Transfers of capital to this fund from the branch's centralized funds and reserves must not be allowed. Moreover, the ministries are obligated to pay fine sanctions for losses caused by the enterprise out of the central ministry apparatus' fund.

In the second form of full cost-accounting, the collective's full cost-accounting income is determined not only by the volume of production produced and its quality but also directly by the efficiency with which all types of resources are used since the rationality with which production resources is used is reflected in the size of the wage fund, which is reinforced by appropriate economic accountability. The normative distribution of income does not allow an enterprise to operate at a loss and pay the collective its wages punctually.

The spread of this form of full cost-accounting has, however, been difficult because of the norms' flaws with regard to distributing income between enterprises, the budget, and the branch. The norms are generally specified as a percentage of the economic unit's income after it pays for its receipts from its physical input. All newly created value is thus taxed (twice; once for the budget and once for the development of the branch), whereas in the case of the first form of full cost-accounting only pure income is taxed. As a result, the higher the capital formed in the collective (for wages, for example), the more income it will transfer to the budget and the ministry. In the first form of full cost-accounting, on the other hand, withholding to the state and branch administrative organs decreases as the wage fund increases.

This creates flagrantly worse conditions for enterprises using the second form of full cost-accounting. It is thought that a unified tax base should be used with both methods of distributing the capital accumulated by primary production units. Thus, for withholding to the budget, this may be the value of reified labor—physical resources and amortization—that is actually expended.

Amortization deductions for the full restoration of fixed production capital should be included in enterprises' incomes in full measure inasmuch as the major portion of these is, in accordance with the norms, sent to the fund for the development of production, science, and technology and thereby facilitates an increase in production efficiency as does that portion of the same fund formed by profit or full cost-accounting income. Nevertheless, the specification of these norms is not yet free from subjectivism. In the Uralsk Motor Vehicle Plant imeni the 60th Anniversary of the USSR, for example, the norms have ranged from 100 to 71 percent during the course of the 12th Five-Year-Plan. On top of this, it is still possible for enterprises to receive unearned amortization capital. The realization of this capital in the recreated process in the form of a real set of labor assets is hidden financing of an enterprise at the expense of the consumer's full cost-accounting income.

The reason for this possibility is the machine building branch's use of an uniform straight line method of calculating amortization. According to this method, amortization deductions are made in accordance with one and the same norm each year over the course of the entire time for which fixed capital is used. Deductions are made within the amortization period right up until the fixed capital is written off or until it is reassessed. Thus, the longer fixed capital is kept on the books, the greater the difference between its amortization value and its actual, depleted value.

To some degree, this explains why enterprises are not very interested in writing off worn-out machinery and equipment. At the production association Vladimirsk Tractor Plant imeni A. A. Zhdanov, for example, more than 40 percent of the park of metal-cutting machine tools and forging and pressing machines are being operated beyond the limits of their amortization periods. At the Moscow Color Television Tube Plant, many types of basic production equipment have exceeded their amortization period by 200 percent. In machine building in general, because of the increase in amortization norms for renovation, the coefficient of the amount of obsolete fixed capital removed from service has decreased fourfold since 1975.

There must be an objective basis for calculating the norms governing the transfer of enterprises' amortization deductions for the complete restoration of fixed production capital to funds for the development of production, science, and technology. It is felt that indicators of the wear of fixed capital and the average service life of their active component that estimate the physical condition of production resources would be sufficiently reliable as this type of base. In that case, the norm for transferring amortization deductions to the funds for the development of production, science, and technology may be determined as follows: $N_a = (W_eW_s - \alpha[1 - (T_nT_a)]$, where W_e is the average wear of the enterprise's fixed production capital, W_s is the average wear of the fixed production capital belonging to the subsector or ministry, αa is the relative share of the active portion in the overall value of the enterprise's fixed production capital, T_n is the norm service life of the active portion of the fixed capital as calculated in accordance with amortization norms, and T_a is its actual average age.

Here W_e is really only within the range of values that are less than W_s, whereas the values of T_a are less than those of T_n. For all remaining values of W_e and L_a, the norm N_a is assumed to equal 1.

It is suggested that besides accomplishing its intended task, this type of methodical solution will make it possible to intensity the restoration process and increase its efficiency. Such a solution will also facilitate active monitoring on the part of enterprises over the condition of their fixed production capital.

UDC 658.155

Problems With Full Cost-Accounting and Self-Finance at Gomel Machine Tool Production Association Discussed

18610063a Moscow VESTNIK MASHINOSTROYENIYA in Russian No 6, Jun 88 pp 71-75

[Article by A. K. Melnikov, engineer]

[Text] As of 1 January 1988 the Gomel Machine Tool Production Association made the transition to full cost-accounting and self-finance. In many respects, operation under the new conditions is determined by the foundation that was laid the previous year. The success that the association achieved in 1987 resulted from the intense work of the entire collective and its purposeful work to improve the production process.

What were the principle results of the association's work during the preceding year?

From the standpoint of contracts, its plan was fulfilled in full measure. Three million rubles' worth of production above the plan was launched and implemented. Production of consumer goods increased 113.6 percent (versus 109.8 percent called for in the plan), and labor productivity increased 108.7 percent (versus 108.4 percent in the plan). The amount of consumer goods manufactured that were rated as belonging to the highest quality category reached 72.1 percent, and 100 percent of the products manufactured underwent certification.

The association is paying increased attention to producing goods for the national economy. In the past year consumer products worth 4,250,000 rubles retail were produced (versus 4.2 million rubles' worth called for in the plan). Fifty thousand rubles' worth of products over the plan were produced. In terms of value, 61 kopecks' worth of consumer goods were produced for each ruble of wages.

The association fulfilled its planned profit quota by 142.4 percent, earning 3.4 million rubles over the amount stipulated for in the plan.

A system of continuous production planning has been in operation at the association for many years. Five-year-plans are tied with yearly plans that are used as the basis for plotting production preparation graphs.

Because of the stability of the conditions established in the plan and the concentration of efforts on its main directions, the changes that ministry made in the plan last year were insignificant.

The association is paying a great deal of attention to developing intraoperation calculation. At the present time all shops, departments, and independent sections are under full cost-accounting. The indicators reached by the structural subdivisions are tied to the end results of the operation of the entire association. Thus, the volume of production realized with an allowance for the fulfillment of contract obligations is the most important indicator for the sales and finance department, the reduction in the number of products rejected as compared with the same period of the preceding year and the reduction in the number of cases where state acceptance representatives returned a product for further work or correction as compared with the previous month are most important for the technical inspection department, and fulfillment of the production preparation graph is most important for the material and technical supply and the technical departments.

Estimated prices and pure production norms are the basis for the planning and accounting of indicators by shop and section. The volume of consumer goods produced, with an allowance for contract shipments, is the main indicator for all shops. For blanking shops, this means finishing the program for the machine shops before the first of the month following the accounting month; for machine shops, this means ensuring that the planned set of components is furnished to the assembly shops; and for assembly shops, this means manufacturing and shipping out the products stipulated by the plan for meeting contracted shipments.

All shops and sections also have a quota for the cost of consumer goods. In addition, individual brigades have a limit on electric power and a norm for consumption of basic materials. The product list plan for a shop and brigade is determined with an allowance for their completion coefficient.

A full cost-accounting grievance system, according to which expenditures over and above the plan are charged to that structural subdivision responsible helps increase the efficiency of full cost-accounting. Disputes related to cross complaints are examined by a full cost-accounting commission, with its decision being final.

Automating management helps in getting jobs as quickly as possible to the specified executors and keeping track of the jobs that have been completed. All of the labor-intensive operations entailed in planning and accounting for shop and brigade indicators are performed in a cluster computer center, which provides the required computations by an established time period.

The results of the operation of full cost-accounting and the entire association are analyzed monthly at meetings of the economic council. The council examines pressing problems related to management and finance, including fulfillment of the plan and the results of the operation of shops and the association, the introduction of new technology, preparations for the transition to the new wage conditions, and the status of the association's working capital.

The problems of updating production and increasing its technical level and quality are at the center of attention. In the past 5 years alone, more than 30 models of new machine tools have been developed and launched into production. Included among these are the model GD-149 pipe-cutting machine tool, the model GD-119 special abrasive cutting machine tool with a wheel diameter of 1,500 mm, the model IR500PM1F4 increased-precision numeric control boring-drilling-milling machine, and the model GD400PM1F4 universal horizontal drilling-milling-boring machine.

At the present time, 11 percent of the association's production is being sold on the world market. Most of its profit over and above the plan is the result of new high-efficiency production and production bearing the state emblem of quality as well as exports shipped at contract prices.

It has been suggested that the technical level of products produced should increase because of the creation of a special office for designing machining centers that opened as a part of the association in 1987. The machining center special design office has been charged with designing machining centers and flexible manufacturing modules, conducting scientific research and experimental work, and testing and debugging prototype machine tools.

Under self-finance, the association's finances and economic condition and the assessment of its operation will, in many respects, depend on the quality of the products that it produces. The USSR Law Governing the State Enterprise (Association) specifies directly that product quality is the determinant factor in the societal assessment of the results of the collective's activity and of the increase in its profit.

The introduction of the state acceptance preceded the association's transition to full cost-accounting. In many respects, the state acceptance helps to prepare for operation under the conditions of self-finance, in which case shipping defective products or products having a low technical level may result in economic hardships in the association's activity.

The state acceptance discovered a number of negative forces demanding quick remedy. Based on comments made by state acceptance representatives, approximately 600 different measures were developed and implemented. The introduction of the state acceptance was accompanied by a reduction in the rhythmicity of production and an increase in labor intensiveness, and supplementary payments for deviations from technology and work above the planned level increased. For example, the labor intensity of machine tool production increased by 180,000 norm-hours, or 7.8 percent. Supplementary payments for deviations from technology and work above the planned level amounted to 166,000 rubles. The technical inspection department increased its ranks by 20. The increases in the number of tests, quantity of additional stands and areas, consumption of materials and electric power, supplementary payments for deviations from the technology and work above the planned level, and number of engineering and technical personnel in the technical inspection department increased production costs to the point where the increase was eventually expressed in the association's financial position.

At the same time, the positive results of the state acceptance's introduction should also be mentioned. Previously, measures to eliminate shortcomings were delayed and not carried out, whereas now they are carried out expeditiously, which has a positive impact on production. The number of returns of consumer goods (men's umbrellas) from bases and their stores has decreased by 40 percent as compared with the previous year. The number of days required for start-up operations on the customer's premises decreased significantly.

The number of trips that plant specialists had to make for warranty service on machine tools came to 114 in 1987 versus 131 in 1986 although the number of machine tools under warranty increased from 76 in 1986 to 104 in 1987.

The plant's existing equipment park was basically formed over the course of the past two five-year-plans. Work to update equipment and improve the structure of the machine tool park helped in achieving the current level of labor mechanization in basic production (79.8 percent) and helped in attaining the current shift coefficient of 1.7. Over the past year 50 units of equipment were dismantled, 44 of them because of the transition to two- and three-shift operation. The dismantling was also related to the provision of production rhythm, which was reduced when the state acceptance was introduced. As a result of a reduction in the number of units of production equipment, 545 m^2 of production area was freed up. It will be used to expand production for installations of new high-efficiency equipment.

To increase the rhythm of production under the state acceptance it is necessary to equip shops with additional numeric control machine tools, test stands, and modern measurement technology.

Work in preparation to the transition to self-finance continued practically all of last year. A transition commission and a working group to develop the basic principles of the transition to full cost-accounting were established by order of the association. The commission and working group including head specialists, department heads, and representatives of social organizations. A plan of measures to make the transition to self-finance was developed and approved.

In accordance with the approved plan, the association's financial condition was analyzed. To simulate the functioning of the association under full cost-accounting and to make an allowance for the new norms and policies, its profit was estimated, its economic funds and sources for generating them were specified, and the expenditures required to expand the enterprise, retool it, operate residential and community services, construct new homes, and expand the social sphere were studied.

Studying the experiences accumulated by those branch enterprises that made the transition to full cost-accounting in 1987 (including the Machine Tool Plant imeni Sergo Ordzhonikidze, the Moscow tool production association Frezer imeni M. I. Kalinin, the Ivanovo Machine Tool Plant imeni the 50th Anniversary of USSR, and a number of other enterprises) was very important in introducing the new management system.

Two forms of study were used to study the USSR Law Governing the State Enterprise (Association) and principles of operating under conditions of full cost-accounting: special courses and a network of economic and party training programs. The party committee adopted a resolution and is taking measures to conduct economic general compulsory education at the association. Foremen and brigade leaders took a course entitled "The Transition of Production Subdivisions to Full Cost-Accounting and Self-Finance." The training culminates in special courses by economists. Groups to train other groups of specialists, including standardizers, technologists, and shop heads, have been created. Diagrams, tables, and other visual aids dealing with profit distribution and the formation and use of economic incentive funds have been delivered to all structural subdivisions.

The association's finances and economic condition were analyzed in detail with the development of economic norms and the state order for 1988. The analysis uncovered contradictions in the new operating conditions and failures to comply with a number of policies in the USSR Law Governing the State Enterprise (Association). The entire state order was included in the production plan for 1988 when it was formulated. The state order came to 96.7 percent of the total production volume and 100 percent of the volume of metal-cutting machine tools produced. It turns out that virtually all consumer goods production must be produced in accordance with the state order. The state order system includes both basic production (metal-cutting machine tools) and the production of spare parts, metal working machinery, special production equipment, consumer goods, scrap, wastes of ferrous and nonferrous metals, and paid services to the public. In practical terms, therefore, there can be no talk of the independence that has been stipulated by the USSR Law Governing the State Enterprise (Association) when the production program is formulated.

Of the 500 machine tools stipulated by the state order and production plan as of 1 January 1988, orders have been issued for 488, and delivery agreements have been concluded for 398. The main reasons why agreements for the shipment of the remaining machine tools have not been concluded are as follows: fund holders did not have multiple purchase orders, buyers did not formulate agreements on time, fund holders did not have the currency to buy the imported component sets required for the numeric control machine tools.

The production plan formulated for 1988 stipulates an 11 percent increase in production volume, a 22.3 percent increase in consumer goods, and a 9.3 percent increase in labor productivity.

Many of the association's problems are in the area of the material and technical support of the production plan, particularly with regard to the production of consumer goods. The physical resources and raw materials required for the state order are not being completely (100 percent) provided in actual practice. Plans and additional quotas for the production of consumer goods are frequently not linked to capabilities of supplying raw material and materials. In 1988, for example, only 2 of the 22 tons of ABC plastic allocated were supplied, and 150 tons of cold-rolled stock was not received. Often, funds are allocated but not secured for supplying plants. Quarterly shipments of raw materials and materials also result in the formation of stockpiles over and above the norm, which has a negative effect on the association's financial condition and does not provide optimum conditions for the normal course of production.

The allocation of funds for products and materials needed to complete sets is currently done in a multistage manner. There are no direct shipments of products needed to complete sets. The product packaging and shipment norms for the electronics industry have been increased, but the enterprises involved in small-series production are not satisfying them. Suppliers, while satisfying the norms from the standpoint of production volume, are not meeting them with respect to product list or range. Allowance for above-norm material costs and their realization has not been organized adequately.

The production of economic norms for withholdings form profit to the state budget and the ministry as well as norms for the formation of economic incentive funds have made it truly possible to estimate the actual resources that an association will have at its disposal in 1988. The norms that were formed on the basis of the 1987 plan and the quotas established for the five-year-plan do not reflect the real need for resources. Each year the enterprise went to the USSR Ministry of the Machine Tool Industry with complaints and objections in order to correct the financial plan: the resources allocated are insufficient to cover losses resulting from residential and community services, expenses for cultural and domestic institutions, and the difference in fuel prices.

The estimates made showed that, when compared with 1987, the balance profit in 1988 will increase by 24.8 percent. In 1989 it will increase by 52.5 percent, and in 1990 it will increase by 126.9 percent. At the same time, the profit remaining at the enterprise's disposal will decrease and will amount to the following percentages of the balance profit: 31.3 percent in 1988, 27.5 percent in 1989, and 19.6 percent in 1990. This is not enough to construct residences, cover all planned expenses, and pay out bonuses for the principal results of economic activities. The enterprise cannot use its earned resources independently since most of its profit is sent to the ministry's fund and the state budget.

The incentive for increasing quality and developing new products is weak under the conditions of self-finance since the enterprise lacks sources for additional withholdings to the economic incentive funds. Under the old conditions, 70 percent of the above-plan profit obtained as a result of incentive surcharges for high production efficiency and for the manufacture of a product with the state emblem of quality were directed to economic incentive funds. The norms for forming the funds were established in the following amounts: 60 percent of the profit remaining at the enterprises' disposal was to be directed to the material incentive fund, 30 percent to the sociocultural measures and residential construction fund, and 10 percent to the fund for developing production.

Under the conditions of self-finance, the profit obtained from incentive surcharges is distributed by following the general procedure in accordance with the established norm. The new procedure for forming economic incentive funds reduced the material incentive fund in two ways. First, only 30 percent of profit is directed to the economic incentive fund versus the 70 percent that was previously directed to the fund. Second, not 60 percent, but only 30 percent of the profit remaining at the enterprises' disposal is directed to the material incentive fund.

According to calculations made in the association in 1988, supplementary deductions at the enterprise's disposal from surcharges for producing products with the emblem of quality and increases in efficiency would have amounted to 830,000 rubles under the old conditions. But under the new conditions, in accordance with the established norms, they only amount to 318,000 rubles. Withholdings to the material incentive fund would have been 500,000 rubles under the old conditions, but they amount to 100,000 under the new conditions. This means that, with a 2-fold increase in production volume in 1990 as compared with 1987 and a 2.3-fold increase in balance profit, the economic stimulation funds will only increase by 17 percent.

Big problems arise with material incentives to designers and technologies when a new product is developed. Under the conditions of self-finance, a reduction in deductions from incentive surcharges may result in a situation where developers of new technology are not interested in creating a new, highly efficient product and launching it into production. And this impedes scientific-technical progress.

The incentive for increasing production volumes and product quality under the new conditions is inadequate. An enterprise that operates rhythmically and makes its shipments on time may end up in a difficult financial position. The existing system of payment for products shipped puts the supplier in an unfavorable position. Enterprises that operate unprofitably and that do not have money in a current account are often unable to settle up for production shipped. After shipping its product on time, the plant does not receive timely payment, which causes it to fail to fulfill its realization plan and creates financial problems for the enterprise. Under the conditions of full cost-accounting, this type of situation can lead to grave financial consequences.

In our view, the state order should account for no more than 60 to 80 percent of an association's production, as is stipulated in the USSR Law Governing the State Enterprise (Association), so as to allow the enterprises to have independence in formulating their production plans. In any case, all (miscellaneous) production other than the basic product list should not be a part of the state order.

The physical and raw material resources required for the state order must be provided in full and with top priority.

Additional measures must be developed to provide incentives for fulfilling the state order on time.

Work to conclude agreements should be organized such that all agreements are fulfilled by the beginning of the planned year. This will help increase the reliability of the estimate and the planning of the realization indicator with an allowance for the fulfillment of contract obligations. In our view, much depends on the organs for material and technical supply and for publishing the respective policies establishing such a procedure.

The following actions are recommended with regard to improving material and technical supply:

—allocating funds and linking enterprises to supplier plants in a timely manner;

—eliminating the multistage way in which funds are received;

—making direct shipments (from manufacturer to user) of all of the components necessary to complete products being funded before the point of a complete transition to wholesale trade and rescinding consolidated shipping norms;

—reducing norms for packaging and shipping products in the electronics industry and making them primarily wholesale;

—introducing one unified system of accounting for shipped production for the whole country so as to make monitoring of shipments easier; and

—organizing a procedure for keeping accounts of unused products and distributing them through a territorial management automation system so as to bring them into the production process.

Economic norms for forming incentive funds should be formulated in such a way as to leave up to 50 percent of enterprises' profits at their own disposal. This will make it possible to implement the process of expanded reproduction by using their own sources without involving any allocations from the budget. The norms should also make an allowance for all the expenditures that an enterprise must make to produce a product.

The previously existing procedure for distributing profit over and above the plan from incentive surcharges should be kept to provide an incentive for increasing quality and developing new production. Enterprises and design offices should have at their disposal sources for stimulating their workers' material interest in designing and manufacturing new and highly efficient production.

The normative correlation between increases in labor productivity and the average wage limits the growth of the average wage. Thus there should be no danger of an unjustified increase in the average wage.

It has been proposed that the system of payment for production shipped be changed by establishing the following procedure. The bank gives the supplier payment credit for the products shipped under a bone fide shipping document (railroad invoice, shipping and receiving act, transport invoice, etc.) and counts it in the volume of production realized, after which credit and a percentage for its use are exacted from the buyer.

Making such a decision will facilitate an improvement in suppliers' financial condition, excluding the possibility of any failure of timely payment for products produced and shipped. The acts of shipping and realizing production will also tally. The latter is very important in evaluating enterprises' operation since the reliability of the indicator characterizing the volume of production realized will increase when an allowance is made for contract obligations and the lack of correspondence between this indicator and that of the volume of production realized is eliminated.

Commentaries, policy statements, and legal directives concerning the USSR Law Governing the State Enterprise (Association) must be developed as quickly as possible.

Work to intensify and expand self-finance is continuing. The experience that has been accumulated by the Gomel Machine Tool Production Association should be used to eliminate the aforementioned shortcomings in a timely manner. The efficiency with which enterprises operate under the conditions of full cost-accounting and self-finance will, in many respects, depend on this.

FMS: Technology, Applications, Breakdowns Evaluated

18610037 Moscow NTR: PROBLEMY I RESHENIYA in Russian No 17 (180), 6-9 Sep 88 p 6

[Interview by NTR: PROBLEMY I RESHENIYA correspondent S. Abramov with P. N. Belyanin, director of the Technology and Organization of Production Scientific Research Institute and corresponding member of the USSR Academy of Sciences under the "Opinions, Evaluations, and Trends" rubric: "Frankly About Robots"; first two paragraphs, NTR: PROBLEMY I RESHENIYA introduction]

[Text] It was not so long ago that enthusiastic words about flexible manufacturing and automaton plants were encountered in virtually every newspaper. But the encouraging reports gradually faded to nothing. Indeed, Academician L. Koshkin even called robots, machining centers, and flexible manufacturing systems "wasteful" new technology in an article with the unambiguous title "Indulgence in Waste" (PRAVDA, 22 August 1988).

Not all specialists share this viewpoint, which was printed under the rubric "Viewpoint" in PRAVDA. Here we are publishing a conversation that our correspondent had with P. N. Belyanin, director of the Technology and Organization of Production Scientific Research Institute and corresponding member of the USSR Academy of Sciences. He does not take such an extreme position on this topic.

Correspondent: Petr Nikolayevich, how do you feel about Academician L. N. Koshkin's comments about robotics—is it a plague brought from the West?

Belyanin: Each person expresses his or her own opinion. In many respects, Lev Nikolayevich is correct when he says that the transition to robots in this country has acquired the nature of a campaign. Here is what he recently wrote in SOVETSKAYA ROSSIYA: "Under the slogan 'Robotization solves everything,' more than 20 ministries have unleashed a wide-scale attack on industrial robots. Considering that most sectors have neither the appropriate forces nor the experience, the robots they create are not only more expensive but also 10 times less reliable than the world prototypes."

The situation has reached the point where robots have literally been foisted upon enterprises, with no consideration for the technical or economic feasibility of their use.

As far as flexible manufacturing systems [FMS] are concerned, the plants received them as, so to speak, a gift, at the expense of centralized funds. And thus they were installed not where they would have done the most good but rather where they were more visible to the authorities.

I repeat: the main thing is their present unacceptably low reliability. If the time to the first breakdown of universal machine tools is assumed to equal 1, then that to the first breakdown of numeric control machine tools does not exceed 0.4 to 0.6, and that of flexible modules is still no more than 0.3 to 0.4. This is the price for the complexity and multiple-component design of flexible production systems.

For this reason, if we want FMS to operate at a full return—and I think that everyone, including Lev Nikolayevich Koshkin, wants this—their operating time until their first breakdown must be 8 to 10 times greater than that of universal machine tools.

Correspondent: As I understand it, this is still not the case. Some flexible manufacturing systems stand idle up to a third of the time.

Belyanin: Unfortunately, a low load is not only characteristic for FMS, even though the consequences are of course not commensurate. This is one of the reasons for the completely set attitude of enterprise managers toward systems: These complicated systems must be introduced, but the problems cannot be avoided and they are new trouble....

Our institute has also encountered this situation. And although the design of the flexible system that we developed seemed complicated to many production workers and to many in the ministry, they nevertheless decided to introduce it.

And it began to work, albeit not immediately and not without difficulties. Yet still there were shops at the plant that "no matter what" produced exactly the same components our line did. Would they suddenly stop? In the end they believed that the flexible manufacturing system is a reality. For the second five-year-plan now our system is producing very complex casing components in a stringent production rhythm.

But let us return to L. N. Koshkin's remarks. But the problem is not confined to reliability. The problem of tool availability is very acute, and tool durability and reliability are in no way satisfactory. There are problems with software and with servicing the systems.

But I would not begin to say that robotics is generally harmful or that we can have no place for it.

Correspondent: Well, would it not be better at present to concentrate our efforts on rotary and rotary-conveyer lines, as L. N. Koshkin suggests?

Belyanin: As we were called upon to do with robots and flexible systems in their time? Understand that you will not find a "magic wand" there. But that is not where the answer lies.

Correspondent: Where then?

Belyanin: It lies in ourselves. Who made the unrealistic forecast of the need for robots? Who allowed the dissipation of designers' and production workers' efforts, and why did it give rise to a situation where about 300 models of robots are produced at 142 enterprises under 18 ministries? Should it continue, or has there been enough?

Now, when solving the problem of robotization in one fell swoop has turned out to be not so simple (and this was clear before) and the sad experience of several enterprises under the Ministry of the Machine Tool Building Industry has provided a better confirmation of this, voices are resounding with the words "Let us not go that way, comrades. Now rotors, that's it, they are what we need."

Correspondent: But indeed are rotary and rotary-conveyer lines really necessary!

Belyanin I am not minimizing the benefits of this technology at all. Let us move from emotions to figures to calculations of the economic effectiveness of using robotics.

Now here the world practice has long and more than once confirmed that using flexible manufacturing systems is feasible provided 5 to 10 different components must be produced each year and provided they must be manufactured in quantities of 50 to 2,000 units. As far as flexible modules are concerned, they are effective in the case of an annual production of any of 40 to 80 different components in quantities from 20 to 500 units.

When expenditures required for programming the machining of a small quantity of components on numeric control machine tools are not recouped, then it may even be worth it to to return to manually controlled universal equipment.

Do not think that I am against rotary lines. And it is stupid to deny their capabilities. It is enough to observe rotary lines in the production of roller chains, aerosol tanks, and other products to assess their high productivity and small overall dimensions.

According to the specialists, rotary and rotary-conveyer lines can produce up to 30 percent of all the components and products produced in the country.

Economic efficiency is the whole point. Only when robots or rotary yield an effect should they be given the green light.

Correspondent: And what will this lead to?

Belyanin: With regard to robotics, which I am still closer too, it will mean an end to the pursuit of value and quantity. Ultimately, how many robots we produce is not the point.

Of course, a fondness has developed for the rumor that we have overtaken Western countries and Japan in the area of robot production.

But the truth of the matter is that this production does not enjoy a demand. There are increasingly fewer buyers for slow-operating and unreliable robots that are not being written into retooling plans.

Furthermore, our robots cost what the best foreign firms are asking. And they are offering high-quality technology while we are forced to pay the same amount of money for questionable novelties.

Correspondent: Is that not why our section was empty at the 1987 international robot exhibition?

Belyanin: And what should we exhibit if our robots basic indicators lag behind the world level? Why, you ask? No suitable components are available. There are no modern numeric program control systems. There are no drives, no reducing gears, no timing belts. Can a good machine be manufactured from discard components?

We now assemble what are basically the so-called simplest manipulators—to put it simply, a mechanical arm whose actions are entirely controlled by a program written on some sort of carrier.

In the rest of the world increasing quantities of complex second- and third-generation robots are being manufactured, and there is talk of a fourth generation with "capabilities" that are great strides ahead of those of previous generations. We also have such models, but we have produced, and what is more, installed very, very few of them.

Correspondent: I have heard that there are definite problems in servicing flexible systems?

Belyanin: How can I say it? Weighing the all the pros and cons... There are not really very many average or highly qualified professionals who want to service FMS. But then young people willingly enter brigades involved in flexible manufacturing.

The explanation is simple: it is perhaps easier for them to complete the retraining and to lose the earnings in the beginning to obtain an interesting profession—one that I can say with certainty is tied to the future of our industry.

Indeed, it is far from everyone who possesses the qualities required to work with this complicated—and I will not attempt to hide it—capricious technology. Not everyone can handle the heavy load of psychological responsibility: when equipment breaks down, regardless of who is to blame, the consequences may be grave for the entire shop or plant.

It is not without reason that special tests have been developed for individuals entering the respective vocational-technical schools. The competition there today is no less than at many higher educational institutions, which, in my view, is the best testament of their popularity.

Correspondent: And the thought of vocational-technical school graduates together with flexible manufacturing systems does not frighten you? Suppose something happens?

Belyanin: But young people are not the only ones who service the systems. In any case, under the conditions that have been created everyone who wishes to change his or her specialty can work here.

What kind of professional training they will receive is another matter. So long as workers are unprepared or poorly prepared to operate the systems, gross breakdowns and equipment failures that reduce the efficiency of an entire system as a whole will, alas, be inevitable rather than a rarity.

To avoid this, the plants that produce flexible manufacturing systems have taken it upon themselves to retrain future operators. Thus, the well-known Ivanovo Machine Tool Production Association imeni the 50th Anniversary of the USSR does not dispatch a system to a customer until all its operators have completed training at the association's training center.

Correspondent: And finally, where in your view will flexible manufacturing systems be used?

Belyanin: In places having qualified technologists, repairers, and operators, a large park of numeric control machine tools, and a well-operating computer center and programming office.

In that case it will be easier to create the conditions required for the system to operate in a true high-efficiency manner—to obtain the required range of components and to keep the equipment from standing idle and operate it for multiple shifts so that the expenses entailed in acquiring and operating flexible manufacturing systems are recouped in the time frames that have been established for automation equipment.

Editorial on Improvements, Goals in Machine Building

18610081 Moscow MASHINOSTROITEL in Russian No 7, Jul 88 pp 1-2

[Article "To Improve Style and Methods of Operation"]

[Text] The second plenary session of the central administration of the All-Union Scientific-Technical Society of Machine Builders took place on 12 April 1988. V. L. Polishchuk, deputy chairman of the central administration and doctor of technical sciences, presented a report entitled, "The Course of Restructuring in the Society's Organizations and the Tasks Evolving From the Decisions of the First Constituent Conference of the Association of USSR Scientific-Technical Societies."

The creation of the Association of USSR Scientific-Technical Societies has made it possible to unite scientific-technical societies on a more democratic basis and on the principles of self-management and self-finance. The association has also made it possible to overcome the lack of coordination among departments and to more closely combine the efforts being made by representatives of the natural sciences and by specialists from different sectors of the national economy in solving large socioeconomic problems.

The principal purpose of the Association of USSR Scientific-Technical Societies is to develop the activity of scientific personnel, engineering and technical personnel and specialists, and innovators in the area of production; make efficient use of their creative potential in implementing the CPSU's strategic course for accelerating the country's socioeconomic development; and involve the entire scientific and scientific-technical community in implementing the decisions of the 27th CPSU congress and subsequent plenary sessions of the CPSU Central Committee related to transferring the national economy to an intensive course of development, increasing the well-being of the Soviet people, and restructuring all spheres of social life. The conference emphasized the need for a radical improvement in the societies' activities and, above all, for an improvement in their style and methods of operation.

At the First Constituent Conference of the Association of USSR Scientific-Technical Societies it was noted that the restructuring of the activities of the organizations of scientific-technical societies is still more a matter of words than deeds. Operating plans are frequently constructed without any allowance for the urgent tasks facing science and production, and the search for new forms of operation is proceeding slowly. Neither has there been adequate dissemination of the progressive operating experience accrued by the scientific-technical society's organizations relative to conducting public appraisals and projects to redesign and retool enterprises and types of production, new machines, equipment, and production technologies; holding idea exchanges and exhibitions of finished scientific-technical developments; or creating temporary creative collectives.

The organizations of the All-Union Scientific-Technical Society of Machine Builders still rarely examine scientific-technical problems, and their creative associations are still insufficiently involved in the development, selection, and introduction of proposals directed toward increasing the technical level and quality of products and the efficiency of production. The positive operating experience that has been amassed under the new management conditions is not being disseminated. Not enough attention is being paid to the problems entailed in developing the technical creative of workers, including youth, and in creating technical creativity clubs.

The administrations and councils of the primary organizations are not paying the required amount of attention to examining the results of their scientific-technical assignments and, in particular, to introducing innovations produced at other organization or obtained from exhibitions. Brigades of specialists belonging to the All-Union Scientific-Technical Society of Machine Builders whose purpose is to provide specific technical assistance to organizations and enterprises including those in other scientific-technical societies are rarely created.

The resolution adopted states that the decisions reached at the First Constituent Congress of the Association of USSR Scientific-Technical Societies are principal activities of the organizations belonging to the All-Union

Scientific-Technical Society of Machine Builders. The All-Union Scientific-Technical Society of Machine Builders must do everything possible to develop the activity of scientific and engineering-technical personnel and specialists and production innovators and must make more effective use of the creative potential of the society's members in implementing the strategic course adopted by the CPSU to accelerate the development of machine building and meet the country's needs for highly productive technology.

Republic, kray, oblast, and municipal administrations and the primary organizations of the All-Union Scientific-Technical Society of Machine Builders must concentrate their efforts on accelerating scientific-technical progress and on retooling and redesigning production as the basis for increasing the pace and efficiency of the economy's development. Accomplishing these goals requires great persistence in solving the problems entailed in updating and advancing the development of the machine building complex; creating new generations of high-efficiency technology; increasing its reliability and operating life; and reducing the amounts of material and power consumed. Also needed is active cooperation to increase product quality; develop and use fundamentally new and progressive technologies and materials, low-waste and waste-free production processes, and ecologically pure products; and improve working conditions. The organizations of the All-Union Scientific-Technical Society of Machine Builders have been called upon to do everything possible to facilitate the accomplishment of one of the most important social and economic tasks—mechanizing and automating production and sharply reducing manual and low-skill labor by introducing progressive equipment, rotary and rotary-conveyer lines, FMS, CAD systems, and automated management systems.

The administrations and councils of the All-Union Scientific-Technical Society of Machine Builders' primary organizations must work continually to increase the role played by the society's organizations in managing production by making more effective use of the rights granted to the society's organizations by the USSR Law Governing the State Enterprise [Association]. Special attention must be paid to the participation of scholars and specialists in implementing a reform of the management of the economy; providing assistance to enterprises and organizations and to branch and territorial administrative organs regarding the introduction of full accountability and self-finance; and studying, generalizing, and disseminating the progressive experience in management and economic operations that has been accumulated.

When planning their work, the administrations and councils of the All-Union Scientific-Technical Society of Machine Builders' primary organizations must proceed from the problems and tasks facing the enterprise labor collectives and regions. The circles of the scientific-technical society must become more actively involved in discussing new directions in the development of science and technology, working out ways of accomplishing them, and becoming active partners or, when necessary, worthy opponents of the state organizations. The members of the All-Union Scientific-Technical Society of Machine Builders must actively participate in implementing plans for new technology and state and regional scientific-technical programs and in the development of the experimental bases required for their quality implementation.

The practice of examining the troublesome issues entailed in developing progressive technologies and creating new technology at the meetings of the presidia of the administrations and councils of All-Union Scientific-Technical Society of Machine Builders enterprises and organizations must be expanded. Society control over the implementation of its proposals and recommendations and over the introduction of innovations must be established. The practice of conducting special competitions, exhibitions of ideas and problems, and exchanges of finished scientific-technical developments must be expanded.

The primary organizations and administrations of the All-Union Scientific-Technical Society of Machine Builders have been called upon to liven up their work, increase their impact on increasing the technical level and quality of products that are manufactured, assume an active role in quality groups, help the state acceptance in every way possible, and use the society's creative potential and resources for the quick solution of all technical problems arising in the process.

The society's organizations should continually improve their style and methods of operation, eradicate bureaucratism and formalism, and show objectivity and self-criticism when evaluating the results of their activity. The main criteria here is that the society's organizations have a real impact on accelerating the development of the machine building complex.

UDC 658.52.011.56.012.3

Development of Design Documentation for FMS

18610027a Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 7, Jul 88 p 23

[Article by V. A. Ganicheva, engineer]

[Text] The institute Ukrorgstankinprom [not further identified] has developed design documentation for the creation of a flexible manufacturing system to machine an auxiliary tool. A period of preliminary design work in which the equipment was studied and monitored preceded this development.

An analysis of the entire product list produced by the plant showed that boring bars, heads, chucks, and holders for a combined tool are the most labor-intensive products to manufacture.

The low level of automation of the machining and the operations of fastening components on the machine tool and later removing them, the absence of multi-machine tool servicing, and a labor shortage determined the expediency of making the change to machining the auxiliary tool under conditions of a flexible manufacturing system. The flexible manufacturing system uses a continuous production cycle to manufacture the auxiliary tool. The system includes machining, heat treatment, washing, and inspection equipment. In view of the current absence of cutting-drilling-boring and grinding flexible manufacturing modules as well as modules to perform the operations of heat treatment and thread grinding (which, by virtue of their mechanical capabilities, are suitable for use in flexible manufacturing systems), the first phase of a lathing system was put into operation in 1987. It was created by combining it with existing flexible manufacturing modules as they are manufactured by domestic industry.

The flexible manufacturing system includes metal-cutting, transport and warehousing, and auxiliary equipment and a control computer complex.

After analyzing the flexible manufacturing modules produced in our country, it was decided to select the 1720PF30RM lathe modules as the system's metal-cutting equipment. These modules, which are slated for production at the Moscow Machine Tool Production Association Red Proletariat imeni A. I. Yefremov, have a 12-position revolving head, a tool dispenser-storage unit, equipment for active inspection, and equipment to remove chips from the cutting area and feed them onto a centralized transport conveyer to a storage site. The components are fastened and removed by an industrial robot. All of this shortens the rough and semi-finishing turning, drilling and boring of holes ranging in diameter from 17.5 to 49.5 mm, and cutting of Tr36, Tr48, and M16 to M48 threads.

The machine tools are equipped with a three-cam mechanized chuck with a floating center. The high power of the machine tool's drives and the speed at which its operations are performed make it possible to make efficient use of the cutting properties of the modern tool throughout the entire size range of components machined.

The machining processes used is that of the group machining of components, which shortens the time required for the technological preparation of production, increases labor productivity, reduces production costs, and improves working conditions and production standards.1

The cutting tool is selected in accordance with the need to machine components in an automated mode and meets the following requirements: it has a modular design; all cutting tools are equipped with hard-alloy multifaceted, nonresharpenable plates with mechanical fastening; the shape of the front surface of the cutting portion of the tool provides chip breaking during all types of operations; and the shape of the cutting plates makes it possible to machine the maximum number of component surfaces with one cutting tool.

An automated transport and warehousing system, which was designed by the All-Union Automated Transport and Warehousing System Planning and Design Institute, is responsible for the intake and storage of the norm stockpile and for issuing blanks and intermediate products in such a way as to ensure a rhythmic production process in the flexible manufacturing system. The system includes the following main components: a rack storage, piler cranes, intake and shipping mechanisms, devices to check the overall dimensions of a container, and hardware for the automatic control system.

The flexible manufacturing system's control system has three levels, the upper level being implemented on the basis of an SM 1420 control computer complex and performing the tasks of online and calendar planning, online accounting and accountability, planning the technological preparation of production, and designing control programs.

The middle level is based on an SM 1300 control computer complex with 100 percent redundancy. Its function is to control a group of production equipment in the flexible manufacturing system. The lower level, which is represented by systems for the numeric program control of production modules and the local control system for the transport and warehousing system, directly controls the actuators of the flexible manufacturing system's production equipment.

The hardware on all of the control levels is interconnected by means of power-operated communications channels.

The economic expediency of using flexible manufacturing systems is confirmed mainly by an increase in the level to which the production process is automated in view of the use of progressive high-productivity equipment and computer technology. In turn, labor productivity is increased (the coefficient of the increase in the productivity of the flexible manufacturing system equipment relative to yearly production volume for one machine tool is 6.9), the number of personnel required is conditionally reduced (by 34 persons), and it becomes possible to operate the equipment on a three-shift basis. This in turn makes it possible to reduce the quantity and cost of equipment required for a comparable production volume.

Not only should a flexible manufacturing system include new equipment and progressive production processes, but it should also introduce new methods of organizing production, labor, and management that are based on the integrated automation of operations related to production of the auxiliary tool.

Thanks to automation of the production process the nature of human labor has been changed.

Footnote

1. Production processes and cutting modes were developed in accordance with the documents "Obshchemashinostroitelnyye normativy vremeni i rezhimov rezaniya na stankakh s ChPU" [General Machine Building Norms for Cutting Times and Modes on Machine Tools With Numeric Control] (Moscow, 1980) and "Normirovaniye operatsiy, vypolnyayemykh na metallorezhushchikh stankakh s ChPU" [Standardization of Operations Performed on Metal-Cutting Machine Tools With Numeric Control] (Moscow, Orgstankinprom, 1982); they are recommended by the Metal-Cutting Machine Tools Experimental Scientific-Research Institute [ENIMS] and Orgprominstrument State Special Planning, Design, and Production Office [GSPKTB].

Interview With Elektrosila Quality Control Manager

18610059b Moscow STANDARTY I KACHESTVO in RussianNo 8, Aug 88 pp 59-51

[Interview by STANDARTY I KACHESTVO correspondent L. A. Nokhimov with Vitaliy Yurevich Yu. Ogvozdin, chairman of the quality control group of the LPEO [not further identified] Scientific Research Institute Elektrosila, "Mandatory But Insufficient Condition"]

[Text] Correspondent: Vitaliy Yurevich, in your speech at the meeting of the subdivisions of the USSR Gosstandart scientific-technical council at which the matter of using the ISO series 9000 standards in the national economy was discussed, you spoke of the danger of exaggerating the role of the quality systems regulated by these standards in solving the problem of increasing the quality of domestic production to the world level. Could you explain what you had in mind in greater detail?

V. Yu. Ogvozdin: Yes, I was speaking about the fact that at the present time, when reform of the management of our country's economy is just beginning to come to life, introduction of the ISO series 9000 standards cannot, in and of itself, provide a radical solution to the problem of product quality. I called the session participants' attention to the fact that when solving the quality problem it is necessary to differentiate the principal, basic factors (among which I include the material-technical, production, and metrological support of production, workers' interest in product quality, and personnel qualifications) from the organization factor, i.e. the quality control system. Each of these factors is a necessary condition for increasing product quality, but they are only sufficient in combination.

In my view, the main obstacle to increasing the quality of domestic production is the negative effect of the basic factors. For this reason, concentrating efforts solely on improving the system for controlling product quality, even using the ISO series 9000 standards, is a repetition of the sad experience with the Comprehensive System for Quality Control in Products [KS UKP]. The very intensive multiyear activity of the quality control system at many enterprises has not resulted in any significant increase in product quality—not at all.

After developing the ISO series 9000 standards from the standpoint of the specific conditions at the Elektrosila LPEO, we reached the conclusion that, in and of itself, introduction of the standards will not entail any special amount of work. That is not to say, however, that we are thus solving the quality problem. The main obstacles are inadequate material support for production and the absence of sincere interest in product quality on the part of the workers. Improving the way in which quality control is organized has become a key resource for improving product quality in those foreign countries where there are no problems with production support and where they have solved their problems with workers' responsibility for product quality. In my view, this explains the development of the ISO series 9000 standards and the increased attention being paid to them.

Considering these facts, when I spoke at the session I raised the question of the need to develop a concept for solving the quality problem in our country and clearly specifying the role and significance of quality systems in solving the problem. It seems to me that this will help us avoid delusions about the capabilities of these systems. It will at least show that they are no panacea from all of the troubles associated with solving the quality problem.

Correspondent: Do you not feel that the universal use the ISO series 9000 standards before the basic problems of controlling product quality are solved is premature?

V. Yu. Ogvozdin: No I do not think so. The introduction, or to be more precise, the use of these standards to improve quality control systems must not be delayed since the role of quality control systems will increase as basic problems are solved during the course of the economic reform. Unfortunately, the transition to full cost accounting and self-finance at several enterprises, as I have come to know, has been accompanied by attempts to eliminate quality control subdivisions and services as unnecessary. It is said that they sat there, ate their slice of the pie, and failed to provide anything besides unnecessary trouble and problems. Such a view is, in my view, erroneous. It not only leads to a loss of qualified specialists in the field of quality control but also results in the disorganization of work related to quality and makes it all the more difficult to venture out onto the international market where customers are already demanding that suppliers prove that they are working seriously to ensure product quality. In particular, we have had to present the respective materials in proposals to conclude a contract to supply turbogenerators to foreign forms.

Correspondent: How does the management of the LPEO Elektrosila feel about introducing the ISO series 9000 standards?

V. Yu. Ogvozdin: They are very positive and serious about it. While at the International Institute of Applied Systems Analysis in Vienna where specialists are working in the field of quality control, the association's general director invited a group of specialists to visit our association. They acquainted us with several of their projects. For me, however, the most important thing was the exchange of opinions as to the state of the art, trends, and prospects for the development of systems product quality control both in our country and abroad. I think that this was not only interesting and useful to us but also to the specialists from the Vienna institute. We proposed that our discussion of the problems entailed in ensuring quality be continued at future meetings.

Correspondent: I would like to clarify whether specialists from the Vienna institute were invited to provide the necessary information, as they say, firsthand or rather to develop specific recommendations for ensuring product quality?

V. Yu. Ogvozdin: Our goal was not to obtain specific recommendations from them. Our specialists themselves have a sufficiently good understanding of our problems, and they know how to solve them. We needed the foreign specialists to discuss our approaches to ensuring quality, to reconcile ourselves with what is being done in the area of quality control abroad, to gain a sense of the world level that has been achieved in this area, and to correlate it with what we are now actually doing or trying to do. If you wish, we needed to evaluate ourselves and our capabilities of solving the problem of increasing product quality.

Correspondent: And how did your evaluation turn out?

V. Yu. Ogvozdin: From the standpoint of the ideology and methodology of systems product quality control, as I understood it, we were in full conformity with the current level. As far as transforming our ideas into practice, as I have already said, the problem lies in basic quality problems. Unfortunately, the solution for these is beyond our association's area of competence.

Correspondent: How is the association planing to introduce the ISO series 9000 standards?

V. Yu. Ogvozdin: We are now entering the second stage in the development of the standards—a comparative analysis of those quality system components that are regulated by the standards and by our Comprehensive System for Quality Control in Products. We will use the results to compile a plan for bringing the association's existing quality control system into conformity with the recommendations contained in the international standards.

Correspondent: From all you have said, it is evidently possible to conclude that accomplishing the task of improving product quality control at our enterprises and bringing this control up to the world level is entirely possible.

V. Yu. Ogvozdin: That is true, provided "bringing the systems up to the world level" is understood to mean conforming them to the recommendations specified in the ISO series 9000 standards. But I wish to emphasize over and over again that the efficient functioning of such systems, as good as they may be, is only possible provided the basic quality problems are solved. The presence of such systems, albeit necessary, is clearly an insufficient condition for enterprises' successful solution of the problem of increasing the quality of the products they produce. I am deeply certain that only a radical reform of the management of the economy can create the conditions required to radically improve product quality.

UDC 658.51.512.2

Ensuring Quality of Engineering Systems in Design Stage

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA: NAUCHNO-PROIZVODSTVENNYY SBORNIK in Russian No 3, Jul-Sep 88 pp 15-17

[Article by Yu. P. Tsarik under the "Increasing Quality, Reliability, and Durability" rubric: "Ensuring Quality of Engineering Systems in Design Stage"]

[Text] Ensuring the high technical level and reliability of products in their design stage is one of the central tasks in ensuring the quality of machine building production. At the present time, 70 percent of all machinery and equipment failures result from design flaws, 20 percent from poor-quality manufacture, and 10 percent from violations of operating rules. The foundation of quality is thus laid during the research and development stage of the process of the creation of a new engineering system.

The wide-scale dissemination of complex automated systems in the most diverse areas of the national economy has necessitated the development of new design methods and technologies.

Various indicators—technical, technological, ergonomic, patent-legal, economic, etc.—are used to evaluate quality when complex systems are designed.

Quality indicators are a set of criteria that are used to evaluate the decisions made in various stages of the creation of complex systems. A difference in operation and production conditions may cause criteria to differ, which leads to multiversion decisions.

The optimum quality level of engineering systems F0 may be determined by the formula F0 = f[b(x), c(x)], where b(x) is the total profit realized by the national economy as a result of the engineering system's introduction, in rubles, and c(x) represents the total expenditures required to develop, produce, transport, install, store, service, and operate the engineering systems, in rubles.

The concept of optimal quality refers to achieving a quality level for the engineering system at which the ratio of total profit due to the system's use to the expenditures required to develop, produce, install, store, service, and operate it is at a maximum (Figure 1).

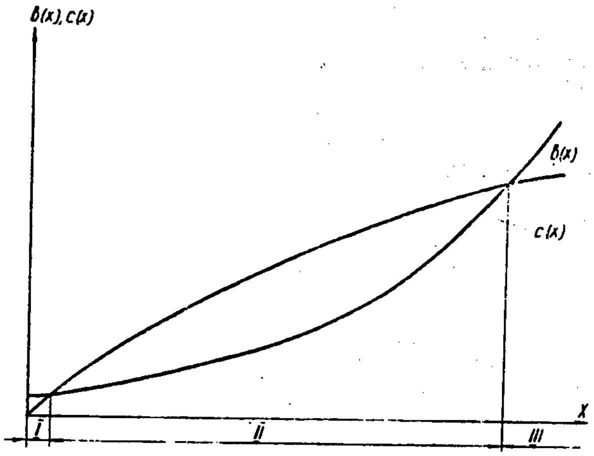


Figure 1. Nature of the Change in Profit b(x) and Expenditures c(x) as a Function of the Quality Level X of the Engineering System

Region I of the graph corresponds to the period when the quality level increases sharply and expenses exceed profit. Next comes the period in which profit exceeds expenses (region II), and finally, expenses again exceed profit (region III) when the quality is further improved. The most favorable quality level is characteristics of region II in the graph.

It is often not possible to establish the boundary of region II precisely. In this case expert evaluations are sought.

According to the concept of controlling the stability of the product's quality, the quality is established in the development stage, supported during the production stage, and maintained during the operating process.

A system's planned quality level depends on a set of factors (Figure 2). Only the entire set as a whole can ensure the production of design documentation having the specified quality level.

Testing prototypes and evaluating the quality of their functioning play a special role in ensuring the quality of engineering systems. A specifications testing center has thus been created at the Welding Equipment Prototype Plant of the Electrowelding Institute imeni Ye. O. Paton of the UkSSR Academy of Sciences. Analysis of the design of complex engineering systems at the specified plant showed that the design process has three principal features:

—Most problems are solved under conditions of incomplete and fuzzy source information and the presence of the uncertainty factor, which necessitates the development of special mathematical and methodological means of resolving the problem of indeterminacy in the initial stages of the design process;

—Compressed time frames for creating complex systems require the intersection and overlapping of life cycle stages (design, creation, operation), which in turn results in an integrated approach to accomplishing tasks in all of the stages; and

—High-quality design of new complex systems is impossible without high-quality software inasmuch as a low-quality program frequently acts as a brake when designs are being developed.

The creation of a unified system to control the quality of engineering systems in their design stage makes it possible to combine and coordinate all things that affect the quality of the system being designed so as to ensure their maximum effectiveness and to achieve the technical level required of the system.

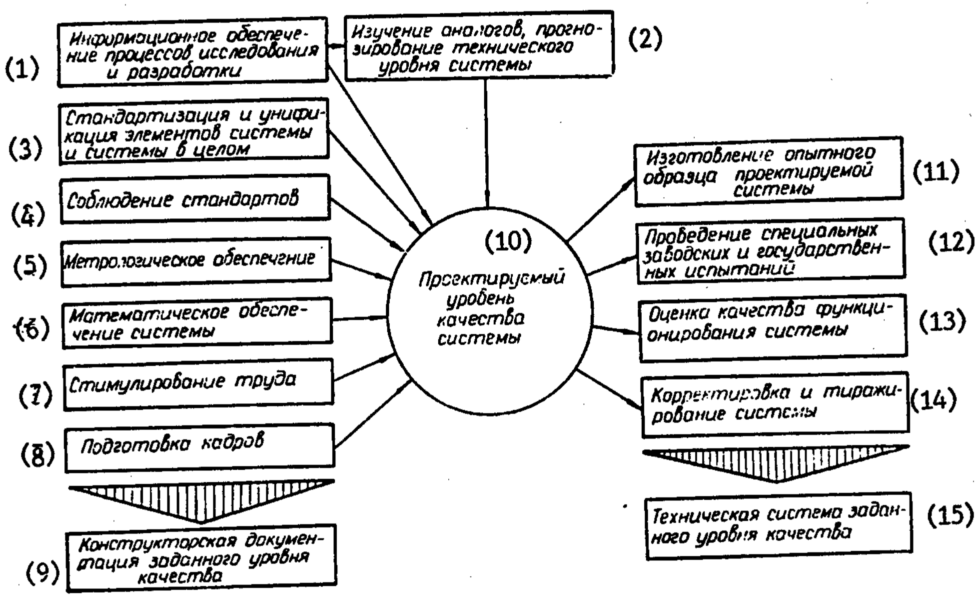


Figure 2. Model of Quality Control During the Design of Engineering Systems

Key: 1. Data base management and organization for R&D processes 2. Study of system analogues and a forecast of the system's technical level 3. Standardization and unification of the system's components and the system as a whole 4. Observance of the standards 5. Metrologic support 6. System software 7. Motivation of labor 8. Personnel training 9. Design documentation having the specified quality level 10. System's planned quality level 11. Manufacture of prototype of system being designed 12. Performance of special plant and state tests 13. Evaluation of quality of system's functioning 14. Correction and circulation of system 15. Engineering system having the specified quality level

UDC 006.354.032:65:658.562

Using ISO Series 9000 International Standards in USSR

Moscow STANDARTY I KACHESTVO in Russian No 8, Aug 88 pp 45-59

[Article by V. G. Bersan and I. I. Chayka, candidates of economic sciences, under the "Quality Control" rubric: "Using ISO Series 9000 International Standards in USSR"; first five paragraphs, STANDARTY I KACHESTVO introduction]

[Text] From the editor. Materials devoted to the ISO's series 9000 international standards, which establish the requirements for product quality assurance systems, have been published in a number of issues of the journal STANDARTY I KACHESTVO. These publications have given a brief description of the standards and have reported on their significance in improving production quality control at enterprises and their role in improving international trade. In particular, it has been mentioned that these standards are now enjoying ever-increasing use in the establishment of trade ties where they serve as models for evaluating the supplier's product quality assurance system. Decisions as to whether or not to conclude the contract were reached accordingly. Observance of the ISO series 9000 thus becomes a factor in whether enterprises raise the competitiveness of their products. There is an international trend toward evaluating the quality assurance systems in operation at an enterprise when the enterprise's products are certified.

It should be noted that in many countries, series ISO international standards have already been adopted as national standards without revision.

Of course, industrial workers will ask how the ISO series 9000 standards should be used in our country, whether all of the specified standards are appropriate for our conditions of economic operation, how to proceed with the experience that the enterprises have accrued in using production quality control systems, etc.

A report on a session of the scientific-technical council of the USSR Gosstandart at which these problems were discussed was published in the preceding issue of this journal.

In the article published here, specialists from the All-Union Standardization Scientific Research Institute discuss and comment on the key findings of an analysis of the ISO series 9000 standards from the standpoint of their conformity with their requirements specified the country's currently existing legislation and also make some recommendations for using these standards.

Specialists from the All-Union Standardization Scientific Research Institute [VNIIS], All-Union Standardization in Machine Building Scientific Research Institute [VNIINMASh], and All-Union Metrological Services Scientific Research Institute [VNIIMS] conducted an analysis of the ISO series 9000 standards. They took ISO standard 9001, the most complete of the three ISO standards—ISO 9001, ISO 9002, and ISO 9003, which are normative in nature—as the basis for their analysis.

The goals of the analysis were as follows: to identify the country's currently existing legislative and normative documents that regulate requirements analogous to those specified in ISO international standard 9001; to compare the analogous requirements of ISO international standard 9002 and domestic documents to determine their conformity with one another; to formulate an opinion as to the possibility and feasibility of the direct use of the requirements specified in the ISO international standard 9001 in the USSR and the need and feasibility of making revisions in the USSR's current legislative and normative documents, particularly in that part that does not conform to the requirements specified in ISO international standard 9001; and to determine the possibility and feasibility of establishing norms corresponding to the requirements established in ISO international standard 9001 in the state standards.

The set of domestic documents analyzed included the USSR Law Governing the State Enterprise (Association), the decrees of the CPSU Central Committee and USSR Council of Ministers concerning matters of product quality, the Policy on Shipments, the Directive on the Procedure for Accepting Products With Respect to Quality, the Policy on the Technical Inspection Department, the SRPP [not further identified] standards, the State System for Ensuring Unified Measurements [GSI] standards, the Unified System of Design Documentation [YeSKD], and other documents.

The analysis showed that many of the requirements contained in ISO international standard 9002 are, to one degree or another, regulated by domestic documents. (It must be remembered that many of these documents are currently being reassessed and that some are being revised.) A number of matters concerning the interaction between enterprises and suppliers, customers, and other organizations are thus regulated by the USSR Law Governing the State Enterprise, CPSU Central Committee and USSR Council of Ministers decree No. 540 of 12 May 1986, the directives of the USSR State Board of Arbitration [Gosarbitrazh], the policies of the USSR USSR Committee for Material and Technical Supply [Gossnab], etc. The requirements relating to the development of a new product are regulated by the SRPP and YeSKD standards, those that pertain to the metrological support of production are regulated by the GSI standards, etc. The overwhelming majority of requirements contained in the series 9000 ISO standards do not contradict domestic legislation and may be used directly in our country.

However, the analysis also indicated that a number of points of ISO standard 9001 contain requirements that either cannot be used directly at the present time or else whose use necessitates appropriate changes in existing USSR documents.

In ISO international standard 9001, for example, it is stated that an enterprise must "select" contractors based on their ability to satisfy a contract's requirements concerning the subcontract, including product quality. The USSR Law Governing the State Enterprise stipulates that "the enterprise determines its need for resources and acquires them wholesale or through a centralized procedure." Thus, in specified cases USSR law stipulates binding suppliers to enterprises. Obviously a complete transition to wholesale trade cannot occur immediately. In this context, the stipulation in ISO international standard 9001 concerning the selection of suppliers cannot be used directly.

Another example is the stipulation in ISO international standard 9001 that "inspection by the customer does not free the supplier from responsibility for supplying a product of improper quality and does not exclude the possibility that it may subsequently be refused." This norm in the stand establishes the unconditional and indisputable responsibility of the supplier and the right of a customer to return a product having improper quality. According to the fiscal legislation of the USSR, the supplier's responsibility is always limited to specified time periods and conditions, which has an objective basis. For this reason the specified ISO norm cannot be used directly. Several flaws in domestic legislation that infringe upon consumer interests were discovered during the course of the analysis of the possibility of using this norm. These flaws must be eliminated.

The main conclusions drawn from the discussion of the issue of the forms in which these standards should be introduced in the USSR may be summarized as follows. It has been deemed feasible to introduce ISO standards 9001, 9002, and 9003 in the USSR as state standards by the "envelope method," i.e., by authentically translating them into Russian and assigning them the corresponding state standard number, with the following notes being made relative to those requirements that can only be used in the USSR provided an allowance is made for the distinctive features of the national economy. State standards that are adopted in this way will be the normative basis in those spheres of activity that we will examine below.

In view of the fact that many requirements set forth in ISO standards 9001, 9002, and 9003 are general in nature and in order to assist enterprises in introducing the standards, it has also been deemed advisable that recommendations concerning the standards' use be developed. It is been proposed that ISO standards 9000 and 9004, domestic documents, and the experience that the country's enterprises have accrued in creating product quality control systems all be used.

The matter of the legality of developing state standards for product quality assurance systems in view of the fact that they primarily regulate the organization of an enterprise's internal activity, which, according to USSR Law Governing the State Enterprise, is the enterprise's main inherent authority, is of fundamental importance. This problem is solved by determining the specific sphere of activity of such state standards. An enterprise enters this domain voluntarily, but within its framework the requirements specified in the standards are mandatory. For example, those enterprises that wish to participate in competitions for a state order may become subject to the standards (the condition that an enterprise's product quality control system conform to the requirement specified in the standards should be included in the Policy Concerning the Competition for a State Order). The standards may be mandatory for enterprises certifying their product (if this is included in the product certification procedure) so that it will be possible to export the product.

It should be noted that economic interest should become the main motive for an enterprise to voluntarily enter the domains of activity under examination.

Besides the aforementioned examples of cases where it is mandatory that state standards for quality systems be observed, all enterprises may use these standards as methodological material to develop or improve their own product quality control system. This is feasible and wise in view of the fact that the experience that has been accrued in the area of product quality control is concentrated in the state standards that will incorporate the ISO series 9000 standards.

All industrial enterprises may thus use the state product quality control standards as methodological materials for developing or improving their own systems. These standards will be mandatory for those enterprises that themselves wish to enter the standards' domain.

In no case should it be assumed that the ISO series 9000 standards mean that everything that the enterprises have previously done in the area of quality control should be forgotten or that a new system should be created.

The danger of making this type of mistake is very real, as is confirmed by the numerous questions that are reaching the VNIIS in regard to this matter.

It should be kept in mind that the overwhelming majority of the principles and policies stated in the ISO series 9000 standards coincide with those requirements and recommendations that are contained in our country's existing methodological materials relating to product quality control systems. For this reason, many enterprises are talking about improving their existing product quality control systems based on the ISO series 9000 standards.

It is also necessary to bear in mind that the ISO series 9000 standards are much more oriented toward specific products than are the product quality control systems that currently exist at our enterprises. Enterprises that produce fundamentally different types of products may therefore have several different subsystems for each type of product. For example, the Moscow Motor Vehicle Works imeni Likhachev [ZIL] may have a subsystem for motor vehicle quality control and one for refrigerator quality control.

The ISO series 9000 standards may be introduced at the enterprises in the following sequence:

—Selection, in accordance with recommendations set forth in the ISO series 9000 international standards, of the model (of the three described in ISO international standards 9001, 9002, and 9003) that is the most appropriate for the product being produced from the standpoints of production volume and quality control requirements.

—Use of all of the system components stipulated in the ISO standard selected as the basis for conducting a comparative analysis of the enterprise's existing quality control relative to a specific type of product. This analysis may reveal that the quality control operation is not being conducted in accordance with several of the components. When this is the case, the development and introduction of such components may become a part of the overall plan of measures to introduce the ISO series 9000 standards.

—Determination of whether or not the components of the enterprise's currently existing product quality control system conform to the requirements specified in the ISO standards. Some specific requisite for the product's production should become one of the objects of the analysis. Any divergence thus detected may serve as the basis for developing additional measures to introduce the ISO standard selected.

Besides the measures established by comparative analysis, the general plan of measures to introduce the ISO standards should also include training for all enterprise personnel (including the highest administrative unit) dealing with the ISO standards.

At first glance, the scheme for introducing the ISO series 9000 standards is simple enough. This simplicity is only seemingly apparent, however. Great volumes of work and numerous specific methods lie behind several requirements that have been laconically formulated in the ISO standards. For example, only several dozen lines have been devoted to the use of statistical methods in the ISO series 9000 standards. In addition, verifying that the specified requirements have been satisfied requires analyzing the many quality control plans used at an enterprise, the methods used for statistical regulation of production processes and statistical analysis, the conformity of the methods used with international and state standards pertaining to the same matter, etc. In accordance with the ISO standards, the specification of requirements for quality control systems may be included in contracts for the product's delivery.

A detailed analysis of the conformity of the ISO series 9000 standards to the methodology for product quality control systems that is currently used in our country and recommendations on the use of each requirement specified in these standards are both beyond the scope of this article. We will therefore confine ourselves to several examples.

The starting point of quality control in accordance with the ISO standards is to take action on quality in all of the stages of the so-called quality loop. This loop includes the following: a study of market demand and requirements; the design and development of specifications and development of products; material and technical supply; preparation of production; the actual production; inspection, testing, and analysis; packaging and warehousing; implementation and distribution of the product; erection and operation; technical assistance and maintenance; and elimination after operation has ceased. Two analogous principles have been formulated in the domestic methodology: quality control in all of the stages of a product's life cycle (research and design, manufacture, handling and implementation, and operation or consumption) and implementation of all of the special functions of management (forecasting the need for a product and its technical and quality levels, planning to raise product quality, etc.—a total of 16 functions). In combination, both principles completely overlap the "quality loop." However, in the sense that many special functions are not reflected in the "quality loop," the two principles present the quality system more fully than does the "quality loop."

In all three standards (ISO 9001, ISO 9002, and ISO 9003) the sections entitled "quality system requirements" begin with the "management responsibility" and "policy in the area of quality." In particular, the following is stipulated: "The management of the supplying company should specify and document its policy, goals, and obligations in the area of quality."

Analogous requirements have been established in the Comprehensive System for Quality Control in Products [KS UKP]. The basic enterprise standard thus recommended formulating the goals and tasks of the quality control system. It was thus proposed that tasks be formulated in specific quantitative expression for a specified time period, proceeding from the system's goals and real capabilities of the enterprise. It should, however, be noted that the purpose of the system was generally formulated in very general terms—impersonally and without really being expressed in the policy that was supposed to guide all of the enterprise's actions and efforts. In most enterprises, the role of the enterprise's higher management in formulating, documenting, and implementing policy in the area of quality control did not materialize.

Special scientific-technical programs for increasing the technical level and quality of production [TsNTP] have recently become popular. Such programs are being developed for specific products. They contain assignments for improving specific quality indicators and a set of supportive measures. The most interesting experience in this area has been that accrued at a number of enterprises in the Saratov oblast during joint experiments involving the USSR Gosstandart, USSR Gosplan, USSR State Committee on Science and Technology [GKNT], USSR State Committee for Labor and Social Problems [Goskomtrud], and USSR Academy of Sciences. At the Saratov enterprises, the programs are a component of the product quality control system and represent a specific form of the implementation of the ISO quality standards related to specifying the goals and tasks in the area of quality and quality planning.

The ISO standards contain the following requirement: "The responsibility, authority, and interaction of all personnel performing and inspecting work that affects quality must be clearly defined." In domestic practice, an analogous requirement is generally implemented through enterprise standards, where those who execute the various functions, tasks, and operations related to quality control are specified, as well as through duty regulations. The authorities of executives and the horizontal links between them have not been adequately specified either, and their measure of responsibility for failure to perform functions and tasks has seldom been specified.

The ISO standards state the following: "The supplier must require and actualize procedures supporting the administration and inspection of product design so as to satisfy the established requirements." Procedures of this type have generally been developed in the Comprehensive System Quality Control in Products in the "Development and Formulation of a Product for Production" subsystem. The SRPP and YeSKD standards, branch normative and technical documents, and methodological materials on the specified matter have also been used.

The ISO standards contain the following requirement: "The supplier must ensure that an incoming product not be used and not be permitted into production until it has been subjected to inspection or some type of checking for its correspondence with the specified requirements." Analogous requirements are contained in the CPSU Central Committee and USSR Council of Ministers decree entitled "Concerning Measures for Radically Increasing Product Quality." The matter in question has been examined in greater detail in GOST 24297-87

"Intake Product Inspection. Main Policies." Enterprises generally use these documents to develop procedures and organize intake inspection relative to conditions at the enterprise.

Some requirements and policies of the ISO standards are virtually not reflected at all in quality control systems. For example, the ISO standards contain the requirement of "accountability" [proslezhivayemost]. The very selection of an equivalent to the English term has caused a problem. "Accountability" is the capability of tracking the prehistory, use, and location of a product (action) or analogous products (actions). If, for example, a product is discovered to have a critical defect that was caused by poor-quality material, "accountability" should make it possible to establish the specific lot to which the specified material belongs and to then identify all of the products that contain components manufactured from this lot of material. "Accountability" is ensured by the corresponding designations of a product on sketches or other documentation throughout all stages of the product's life cycle. In practice, it is far from all enterprises that do this.

Another example of the policies set forth in the ISO standards that are not implemented during quality control at our enterprises is the accounting for expenditures on quality and their subsequent analysis.

The examples examined indicate that a number of policies and requirements specified in the ISO series 9000 standards are in full conformity with the domestic ideology and practice of product quality control. These policies are used at enterprises and within the framework of product quality control systems, and there are specific regulations governing them. Some policies are used in part or not at all.

For this reason, a comparative analysis of the ISO series 9000 standards and product quality control systems existing at an enterprise must be conducted in each specific case.

The USSR Gosstandart and VNIIS receive numerous questions about the role of the ministries' head and base organizations in introducing the ISO series 9000 standards at branch enterprises. In our view, the introduction of this series of standards by the enterprises will be complicated unless serious ministry organizations provide the enterprises with methodological assistance. Indeed, as one may understand from this article, the ISO series 9000 standards represent only the tip of the iceberg in the form of the most general requirements. The entire iceberg consists of specific methodologies, forms, and methods of operation that very few enterprises have mastered.

UDC 621.771:621.833.2.004.67

Study of Possibility of Using Hot Rolling To Restore Bevel Pinions

18610089 Minsk VESTSI AKADEMII NAVUK BSSR: SERYYA FIZIKA-TEKHNICHNYKH NAVUK in Russian No 2, Apr-Jun 88 pp 54-59

[Article by O. I. Kuzmenkov, V. V. Mosiyenko, Problems of Reliability and Durability of Machines Institute, BSSR Academy of Science]

[Text] Increasing the reliability and durability of the drives of machines, machine tools, and motor vehicle transmissions is one of the most important problems in machine building. Bevel wheels play an important role in machine drives, and their durability often determines the durability of both the drive and the machine itself.

An analysis of heavily stressed round-toothed gearings showed that the main types of defects causing gears to be classified as rejects are abrasive wear, breaks, and chips, particularly on the outer face of the ring.

Most bevel gears encountered in domestic industry have been semi-generated. The hot stamping method is widely used in roughing them. Gears for the drive axles of GAZ and ZIL vehicles are currently cut by this method.

Research on the possibility of regenerating and hardening round-toothed bevel gears is currently being conducted at the Problems of Reliability and Durability of Machines Institute [INDMASh]. This research is based on the experience that has been accumulated relative to regenerating spur gears by the rotary plastic deformation method, which is based on redistributing metal from the nonworking zone to the zone in which the teeth are subjected to wear during the rolling process.

The possibility of regenerating gears was studied on a 535 rolling mill designed by the Automobile Industry Technology Scientific Research Institute [NIITavtoprom]. The components are heated by a work coil from a high-frequency current generator with a power of 60 kW and frequency of 8 kHz[1].

The production process entailed in regenerating a bevel gear[2] manufactured from 20KhN3A and 55PP steels by the rotary plastic deformation method includes the following operations: selecting pinions that are suitable for regeneration (with no large chips, cracks on the teeth, or a ring made of defective stock) and preparing the gears for rolling. The latter operation includes the following: annealing, manufacturing compensating washer and production bushings (by stamping or turning), spot welding the washer and pressing the production bushing into the hole, drilling holes coaxially in the washer and even holes in the hub of the gear, grooving the base (hub) to the depth of the unit in the mill chuck, and trimming the production bushing flush with the gear's hub. The gear rim is then heated to between 950 and 980°C and rolled on a model 535 mill until the wear on the rim is eliminated (Figure 1).

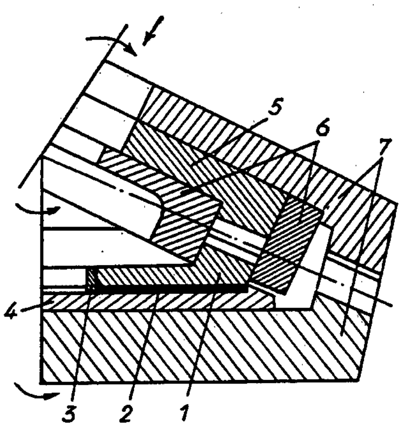


Figure 1. Production Scheme of Rolling a Worn Pinion With a Compensating Lining

Key: 1. Blank 2. Compensating lining 3. Production bushing 4. Chuck plate of gripping chuck 5. Roll burnisher 6. Restricting flange 7. Synchronizers

The worn gear (1) with a compensating washer (2) welded to its face and with a production bushing (3) that has been pressed into it and welded is mounted in the mill's chuck. It is then subjected to high-frequency current heating and plastic deformation, after which the tooth profiles are cut with a roll burnisher (5) with restricting flanges (6) and synchronizers (7). The tooth profile is shaped by redistributing the metal by swaging along the worn teeth with the formation of the allowance required for subsequent machining.

After the rolling, the component is normalized and machined in accordance with the standard production process. In the final operation the component is subjected to high-frequency current hardening and subsequent straightening. The depth of the hardened layer on the teeth is no less than 2 mm, and it has an HRC of 58 to 65.

Three series of experiments were conducted to research the possibility of using rotary plastic deformation to regenerate bevel gears. The first series entailed verifying the possibility of using a series-produced 535 mill without any readjustment to regenerate bevel gears. The purpose of the second set of experiments was to roll six specimen bevel gears with different degrees of wear, chips, and cracks in their teeth and with compensating washers having different thicknesses (3, 4, 5, 6, and 7 mm) and to select the optimum washer thickness and temperature for heating the gear. The goal of the third series was metallographic analysis.

The analysis of a regenerated tooth of the specimens rolled established that the optimal thickness for a compensating washer ranges from 4 to 5 mm, depending on the wear. In the case where the washer is less than 4 mm thick, there will not be enough metal to fill the microcracks and chips and to compensate for the tooth's wear. As a result, individual sections of the teeth are not filled. At thicknesses of more than 5 mm it becomes necessary to overfill the tooth gauge. When this is done, the metal moves to the inner face of the gear rim and is extruded out from under the inner flange of the roll burnisher and pours over into the hub, partially covering the fastening holes on the face of the gear disk and thus complicating any subsequent turning on a lathe.

The empirical selection of the washer thickness is confirmed by a very simple geometric calculation: $S=p_1+p_2+p_3$, where S is the washer thickness (in millimeters); p_1 is the allowance for machining after rolling (in millimeters) ($p = 4$ mm); and p_2 is the allowance for regenerating the worn layer of the gear rim (in millimeters): $p_2 = \delta \sin \alpha \cos \alpha$ where δ is the wear to the tooth in millimeters (with δ ranging from 0 to 2 mm); α is the angle of the initial contour (in degrees) ($\alpha = 20$ degrees); and p_3 is the allowance for regenerating the chips (in millimeters).

Since a chip is characterized by a variable value that is impossible (for practical purposes) to take into account, we will assume that $p_{3max} = 0.7$ mm, from which $S_{min} =$ 4 mm and $S_{max} = 5$ mm.

The temperature required for heating when the tooth is cut in a blank is determined by the free flow of the material. For 55PP steel, it fluctuates within the range from 1,150 to 1,220 degrees C.

The temperature required to heat a gear of the very same material in the case of plastic deformation of worn teeth is significantly lower. This is because of the small degrees of deformation. The process of regeneration by rotary plastic deformation occurred in the temperature range between 950 and 980 degrees C.

Chips formed on the outer face of the teeth in two of the specimens after the rolling. As it turned out, these specimens were not subjected to annealing before rolling. Consequently, annealing pinions that are being prepared for regeneration is a mandatory operation before rolling.

The third lot of gears (3 units) underwent special preparation before rolling. Besides a compensating ring and production bushing, each tooth and space between teeth in each of the gears had three blunt bolts with even intervals from the tooth to the space between the teeth pressed into them (Figure 2). Three holes were drilled into the tooth of one of the gears without pressing any blunt bolts into them. A cutting tool was used to make a radial network of marks on the compensating washer welded to the gear. One of the specimens underwent full heat treatment and machining. The experiment showed that the quality of the welding of the washer along the contour was unsatisfactory. In view of this, spot welding is recommended for the sake of strength when fastening the washer to the gear face.

In one of the gears, the straining force of the roll burnisher ripped the washer from the flange. The specimen was superheated (the temperature being approximately 1,250 degrees C). The face of the specimen was not perfectly flat; it had a deviation of more than 10 mm. A similar phenomenon necessitates strictly observing the temperature conditions of rolling and reinforcing the production bushing's weld.

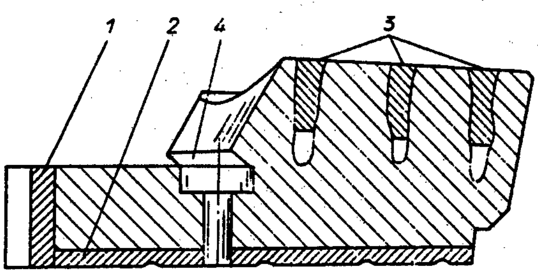


Figure 2. Cross Section of a Gear Rim With Blunt Bolts in the Tooth

Key: 1. Production bushing 2. Compensating washer 3. Blunt bolts 4. Roll

Before rolling, the cell diagonal of the washer's radial network measured 17 mm, afterward it still measured 17 mm. The flange face was flat to within 4 mm before and after rolling, i.e., the gear flange did not become "stretched flat" when the technology was observed (i.e., when the temperature and rolling force were kept within acceptable limits), and the tooth was restored to its initial dimensions without any reduction in durability.

Templates were prepared for the metallographic analysis. Their borders extended along the most characteristic cross sections of the gear so as to be able to judge the plastic flow of the material and the stresses active within the gear's material. The cross sections passed along the tooth and tooth space covered by the blunt bolts.

The worn gear was rolled flat during the rolling process. After the gauge was filled to the length of the teeth, the metal continued to change its shape until the gauge was completely filled. The directions of the flow of metal as well as the effect of the straining forces were confirmed by the shape of the blunt bolts pressed into the tooth and the space between teeth before rolling.

By using the methods of applying metal onto the nonworking surface of a worn bevel gear and subsequent hot rolling on a 535 mill, we obtain a specimen with 90 percent of the wear removed and 100 percent of the chips and microcracks removed.

When the rolling was done both on the tooth surface and in the space between teeth, there are distending stresses directed toward the rim's inner crown that displace metal into the wear zone and into the facial chips and that form burrs on the gear rim's inner face. The effect of the rolling forces that create stress along the tooth and that move from its head to its root and the compressing transverse stresses that are directed from the tooth's working surface to its nonworking surface explain the ellipsoidal, almost droplike shape of the holes in the tooth, which flare out from the root to its peak. The axis of the holes coincides with that of the tooth in its cross section. The barrel shape of the central blunt bolt and the one that is pressed to the inner face of the tooth rim that is observed may be explained by the effect of the compressing forces, thanks to which the gauge is filled and the teeth are regenerated in this section of the tooth rim.

The deep processes involving both distending and compressing stresses may be described by constructing a mathematical model based on point calculations of the forces operating in the gear's material by using one of the current calculation methods (for example, the finite elements method).

The research showed that gears being prepared for regeneration of their worn teeth by rolling their rim should satisfy the following requirements:

The metal of the gear's flange should be redistributed to the rim in an amount compensating for the amount of wear and chips plus an allowance for machining;

An excess of redistributed metal causing overfilling of the tooth-rolling gauge is unacceptable;

Superheating of the component, resulting in a loss of the fastening strength of the compensating washer and production bushing, is unacceptable; and

Components should be annealed before rolling.

A strength calculation performed in accordance with a previously described method[3,4] showed that gears regenerated by using the rotary plastic deformation method are no less serviceable than new gears. In some cases, their service life even surpasses that of new gears.

When the durability of a regenerated gear is compared with that of a newly manufactured gear, it is discovered that rotary plastic deformation results in a better microstructure and that the limit of buckling endurance increases by 25 to 30 percent. The effect of a compensating washer is evident in a 2 to 3 mm reduction in the thickness of the gear rim. Given the existing twofold margin in fracture strength, this weakening of the rim does not, for all practical purposes, reduce its life. This is in good agreement with data from field tests conducted at the Borisov Auto Repair Plant[1].

Methodological materials dealing with determining the economic impact of new engineering and progressive technology in automotive transport were used as the basis for calculating the economic impact of the production process of regenerating 51-2402060A2 gears by means of the rotary plastic deformation method.

The existing process of manufacturing bevel gears by hot rolling that is used at the Minsktraktorzapchast [Minsk Spare Tractor Parts] Production Association of the Minsk Pinion Plant (see the table) was used as a control in the calculation of economic impact.

Source Data for Calculating Anticipated Economic Impact

Data	Base	Plan
Plant's yearly program	100,000	100,000
Cost of equipment, allowing for transport costs	500,000 rubles	500,000 rubles
Amortization deductions	13.5%	13.5%
Wages of workers in all operations in manufacturing one component	0.189 rubles	0.149 rubles
Electric power consumed by equipment to manufacture one component	0.21 rubles	0.15 rubles
Tools required to manufacture one component	0.264 rubles	0.185 rubles
Metal required to manufacture one component	2.64 rubles	0.2 rubles
Addition to cost of metal for special properties of steel	0.10 rubles	—
Wastes returned (for remelting) per component	0.247 rubles	—

The anticipated economic impact was calculated in accordance with the formula Impact = $(Ex_1 - Ex_2)A = (C_1 - C_2)A - E_N(K_2 - K_1)$, where Ex_1 and Ex_2 are the total expenditures required to manufacture one component of the base and design versions, respectively; C_1 and C_2 are the costs of manufacturing one component; K_1 and K_2 are capital outlays; and A is the plant's yearly production program.

Since, according to the plan, the gears will be prepared for regeneration at the repair plants belonging to State Agroindustrial Committee [Gosagroprom] enterprises whereas the regeneration will be done at the manufacturing plant, no additional capital outlays need to be added. Consequently, impact = $(C_1 - C_2)A$, i.e., impact = $(3.403 - 0.931)100,000 = 247,200$ rubles.

Because of the dismantling of the assembly line for producing and regenerating No. 2402060A2 bevel pinions at the Minsk Pinion Plant, preparations are currently underway to set up the new technology for regenerating the pinions of motor vehicles' rear axles at the Orshanka Tractor Repair Plant. A model 535 tooth-rolling mill has been installed at the Orshanka Tractor Repair Plant for this purpose.

Conclusions

1. The possibility of using the rotary plastic deformation method plus a compensating face lining to regenerate the spiral-bevel pinions of the main pair of the rear axle of a GAZ-51A vehicle (component No. 51-2402060A2) has been demonstrated.

2. Based on the results of metrological testing, it is evident up to 90 percent of the wear and up to 100 percent of the chips and microcracks in specimens regenerated by rotary plastic deformation are eliminated.

3. It has been established that, depending on the wear, the optimum thickness for a compensating lining ranges from 4 to 5 mm, which amounts to (0.5 to 0.6)m.

4. Superheating of the component resulting in a loss in the bond strength of the compensating lining and production bushing is unacceptable. The temperature for heating a component made of 55PP steel during plastic redeformation should be within the range 950 to 980 degrees C.

5. The effect of a compensating lining does not significantly reduce the durability of the wheel rim. Thus, given the existing twofold margin in tooth fracture strength, there is practically no reduction in the service life of regenerated gears.

6. Considering the great need for enterprises under the BSSR Gosagroprom to use high-efficiency technologies for regenerating worn components, the technology for regenerating bevel pinions using hot rolling that has been described in this article is recommended for introduction at the specified enterprises.

The authors thank A. A. Sverchkov, director of the Borisov Repair Plant, for his help in conducting the experiments described in this article and in organizing field tests of the regenerated components.

Bibliography

1. Kuzmenkov, O. I., Mosiyenko, V. V., Sverchkov, A. A., et al., INF. LISTOK. BelNIINTI, No 83-240, Minsk, 1983, pp 1-5.

2. Author's certificate 946758 (USSR), BYUL. IZOBRET., No 28, 1982.

3. Tsitovich, I. S., Kononik, I. V., and Vavulo, V. A., "Transmissii avtomobiley" [Motor Vehicle Transmissions], Minsk, 1979.

4. Ostroverkhov, N. L., Soliterman, Yu. L., Ryzhkova, O. V., et al., "Prognozirovaniye srokov sluzhby zubchatykh koles transmissiy na EVM. Operativno-informatsionnyye materialy INDMASh AN BSSR" [Computer-Assisted Forecasting of Service Life of Transmission Gears. Operating Information Materials of INDMASh, BSSR Academy of Sciences], Minsk, 1978.

UDC 659.152;659.157

New Products From Robotron

18610027c Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 7, Jul 88 pp

[Article by L. A. Khantseva, engineer, under the "GDR Exhibition in Moscow" rubric: "New Products From Robotron"]

[Text] The K 1840 (SM 1710) virtual memory computer (Figure 1) [not reproduced] is intended for use in creating high-productivity systems for several users. It is flexible to use, has a variable configuration, and processes data at a high speed. It may be used in production in different sectors of industry. Its high efficiency is the result of the following: rationalization of design and planning operations (CAD), a plant technology management automation system, planning and quality control, and an automated labor management system.

Technical Data on the K 1840 (SM 1710) Virtual Memory Computer System

Speed, of operations/s	More than 1 million
Memory size	2-16
Virtual address region, Gbyte	Up to 4
Expansion of external memory, Gbyte	Up to 3
Information transmission speed, Mbyte/s	Up to 2

The system meeds the processing requirements for several users, multiprogram processing, memory management, processing user programs along a perimeter and time quanta, and batch processing.

The K8140 (SM 1710) ultra-high-power minicomputer has microprogram control, more than 300 effective instructions, a set of addressing types, and the necessary data types. A console system based on a K 1620 is the connecting link between the operator and computer system.

A central processor, which consists of an arithmetic unit, an addressing unit, and adapters with a floating decimal point, controls the bus system and memory, the microprogram memory, the instruction processing, and the buried memory. The main memory consists of units of 2 Mbyte each. When the network is disconnected, information is preserved for 10 minutes.

The I/O system consists of two subsystems: the SM computer bus system and a subsystem of bulk storage buses (to connect the memory to magnetic and removable disks).

The Robotron A 7150 (SM 1910) modular structure professional personal computer (Figure 2) [not reproduced] consists of a base computer, display, and keyboard. The central processor is based on a 16-bit microprocessor. The logical modules operate from a microcomputer. The capacity of the main memory is 768 Kbyte. The A 7150 (SM 1910) may be connected to digitizers and graph plotters as well as to hierarchical systems and communications systems. Because of this, it is suitable for performing complicated tasks in CAD and plant technology management automation systems. Robotron offers four operating systems, DCP, SCP 1700, BOS 1810, and MUTOS 1700, which transform the computer into a device having multiplane use.

The following are the main areas in which the Robotron A 7150 (SM 1910) is used: tasks related to CAD and plant technology management automation systems; automation of operations on laboratory and test stands; design and the technological preparation of production; design and technology; software development; and accounting, accountability, data collection, and processing of related text.

The Robotron YeS 1834 professional personal computer operates both independently and in the form of a terminal. The Robotron YeS 1834 system unit includes an entire central processor with a 16-bit microprocessor. It has a 640-Kbyte working storage. Between 2 and 4 floppy disk drives, each with a capacity of 720 Kbyte (of format information), or a 40-Mbyte magnetic disk unit is used as external storage units.

The computer may be connected to a black-and-white or color graphic display as well as to such peripherals as graph plotters, graphics tablet and digitizers, and printers. The software for the Robotron YeS 1834 computer includes the following: a DCP operating system, higher level programming languages (BASIC, TURBOPASCAL, C, FORTRAN 77, MODULA 2), standard software, and integrated applications packages. The high productivity and extensive software of the Robotron YeS 1834 computer allow its user to rationalize office work and process text in supply departments and instructional settings and to perform scientific-technical tasks.

The IMAGE-C automated digital image processing system, which has increased universality, flexibility, and economy, is used primarily to analyze photographs taken under a microscope and to process macroscopic and telemetric photographs. An applications package for processing images in the language C is also available for the IMAGE-C system. An interpreter for developing or processing image processing algorithms in an interactive mode also comes with the system.

The Robotron A 5230 system for collecting working parameters is intended for use in keeping track of information directly from production or nodal points of a plant information stream, forming files from these data, and presenting this information in prepared form for online planning or production control tasks (for processing reports, for example). The computer's system architecture makes it possible to expeditiously distribute intelligence within the system's framework, and it allows a different configuration and practical forms of use. The core of the system is its control unit and modern microprocessor design with two 16-bit functional processors (for collection and processing).

The following system solutions are included in the A 5230 system exhibited: a real-time data processing system, a MUTOS 5230 file processing system, an interpreter system for working with files, communications programs, and emulators for offline devices controlled by SCP (the 1715 personal computer and the 8915 data terminal).

A local area network for rationalizing clerical work and CAD/plant technology management automation systems makes it possible to combine the receipt, processing, storage, and use of information into one integrated, decentralized intraplant information system. The local area network performs the following functions: decentralized collection and preparation of information, transmission of files and messages, access to central resources (files, storage units, high-speed printers), text and formula processing with centralized storage, information retrieval in centralized files, and control of users for purposes of effective data protection. Implementation of the CAD and plant technology management automation system designs provides quick access to centrally stored information and quick exchange of information between workstations, which is very important when automating and standardizing design and production processes.

The Robotron YeS 7230 laser printer operates on the basis of a laser-xerographic principle as an output printer in YeS computers for many users. The Robotron YeS 7230 laser printer is the first nonimpact printer operating on ordinary paper created for YeS computers. The new principle of producing contrast improves not only print quality but many other important parameters as well, including the reserve of characters and variability. It has a print speed of 20 sheets per minute (sheet format, A4). When standard economical type is used,it is possible to place an image on one page in the A4 format that would require a page one and a half times as large if a parallel-action electromechanical printer were used. The Robotron YeS 7230 laser printer is offered with different accessories and different productivities. Its basic configuration is such that it can be easily changed to make use of its expanded capabilities. Its output can be produced page by page on individual sheets. Thanks to repeated output, the device can produce up to 8 copies of one page. This printer provides convenient access to all functional nodes and their components, which makes maintenance operations easier.

The P3040 current circuit tester serves to establish defects encountered in the production of complex printed circuit boards for digital technology such as failed components, short circuits, and breaks. The most modern microelectronics technologies are used in the tester. They have convenient-to-use software for developing their own special test programs. Existing interfaces may be used to connect them to other equipment in CAD and plant technology management automation systems.

The P3000 electromagnetic circuit tester is used for the intake inspection of unassembled circuit boards, and it makes subsequent high-efficiency series testing with a P3040 tester easier. This tester also has convenient software for its own programs in a prototype instruction mode.

The people's combine Robotron is presenting diverse software for computers and personal professional computers in the form of system, standard, and branch programs.

The ARIADNE DCP integrated system should also be mentioned. In accordance with the world trend, the universal-use program package combines the following sets of functions: text processing (preparation, revision, formatting, and formulation of any type of text with the capability of checking for correctness and for repetition of words); direct input; file processing and output; tabular calculation for performing various computations with the results visible right there; business graphics for compiling Gant diagrams; and the production of coordinate, circle, line, and derivative diagrams based on data banks or tables with graphics. In addition, the integrated programming language is used to help users develop programs.

The DCP window editing program is a fast full-screen editor. In other words, it is a program that is used when the operator has an entire screen at his or her disposal. It is simple to control and understandable to the beginner. The editing program has the following functions: activation of all instructions by function keys; simultaneous processing of six texts; indication in windows selected at will; copying, deletion, renaming, and inclusion of files; high-speed positioning into any place; and single or global search and replacement (forward and backward).

In the field of YeS computer software, the enterprise Robotron-Proyekt [Robotron-Design], which is located in Dresden, is presenting high-productivity operating systems and compilers together with the YeS 1057 computer. Improved standard programs such as the DBS/R-6 operating system and mathematics software for mathematics operations based on these operating systems and compilers is also presented. This hardware and software is used in the following sectors: metallurgy (at plants manufacturing high-quality steels), chemistry (at a fertilizer plant), electronics (to automate the process of producing ferrite), and in the hotel industry. A program to manage the production of motors for lightweight motor vehicles is being used as a draft plan in machining building.

To become acquainted with the new products of the Robotron combine in greater detail, one can visit the "GDR in Moscow" exhibition, which will be held from 16 September to 9 October 1988 at the USSR Exhibition of National Economic Achievements in Moscow.

UDC621,7.073.001.2

Automating Design of Dies

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA: NAUCHNO-PROIZVODSTVENNYY SBORNIK No 3, Jul-Sep 88 pp 27-28

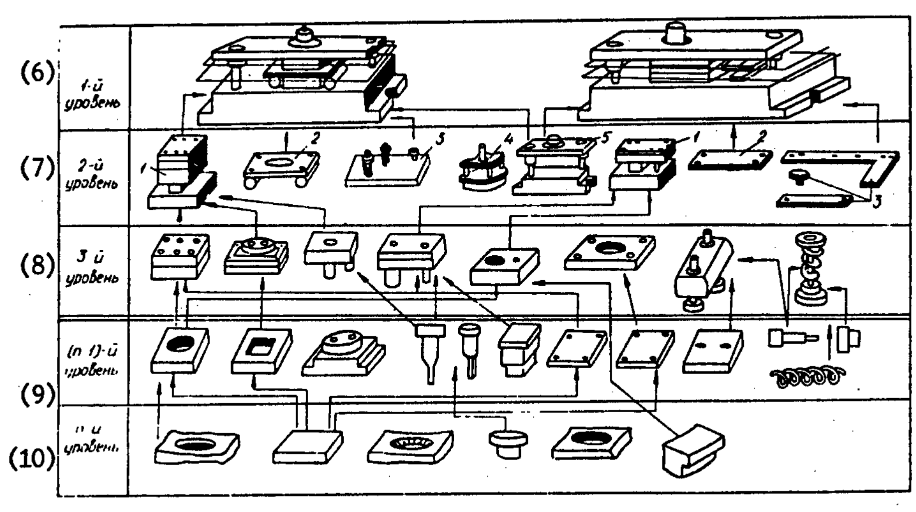
[Article by M. I. Bekker]

[Text] At the Special Engineering Equipment [Spetstekhosnastka] Scientific Production Association in Odessa research is being conducted on existing CAD systems for designing dies and such CAD systems that are currently in the development stage. It has been established that those CAD systems that are based on designer-computer interaction are most promising inasmuch as the design process is a step-by-step process that demands a great number of calculations and logical deductions. Modern graphic representation methods make it possible for the designer to see the results of his design at any moment. The computer may thus propose the optimum versions and previous design decisions for a set of objects. The designer makes the final decision.

The following fundamental principle must be adhered to when designing a CAD system: it is the design of the die that is the research object. Each standard design may be broken down into its component parts (elements), i.e., components, subassemblies, elements of the die's shape, and the die's functional systems. In a standard design, these elements occupy definite places and perform established functions. The design of a die having a specified purpose thus has a corresponding structure.

A combined-action die for chopping off components and piercing holes thus consists of a die and punch, a system for orienting and fastening blanks, a waste removal system, a system to eject the finished component, and an enclosure. A series-action die also includes data systems. Many functional systems are designed by using one and the same methods for several standard die designs. This makes it possible to specify the structure of the die being designed unequivocally (see the Figure). CAD is thus considered to be a set of subsystems designing each of a die's structural units, i.e., the components of the design as well as the die as a whole.

The first stage in developing the design of such a system is that of creating an information base by developing an



Structure of a Standard Die Design

Key: 1. Working parts 2. Removal system 3. System for orienting and fastening blanks 4. Ejection system 5. Block 6. Level 1 7. Level 2 8. Level 3 9. Level n -1 10. Level n information chart of the die's design component. It presents information for specifying the component's image and shows its parameters, calculation methods, source and output data, the method used for depiction in a sketch, the functions to be performed by the component, and the area in which it will be used. If the design component's parameters and shape already exist, the specified component is standard and is entered into the base set. If the shape already exists but the parameters are being specified during the design process, the component is called a typical component. Special components whose shape and parameters are specified during the design process may be typical components. The information that is required to calculate the parameters of special and typical components is presented relative to each of them.

The design components are arranged by level in a strictly hierarchical order. Besides information on the design components, the system's base information also includes a number of design norms (tolerance tables, minimum distances from the edges of the components to the holes under the fastening components, the nominal dimensions of connectors in drop-outs, etc.).

During the design development process it is very important to develop a scheme for creating a standard design from a set of die components and to specify a scheme for interaction between designer and computer.

The results of the design development are source data for developing CAD algorithms and programs.

UDC 621.9-589.8

High-Precision Indexing Devices

18610074a Moscow VESTNIK MASHINOSTROYENIYA in Russian No 9, Sep 88 pp 46-48

[Article by A. M. Yeseyev, A. I. Markhula, Ye. I. Movchan, and A. V. Terekhov, engineers]

[Text] Diverse universal indexing devices ranging from different types of indexing heads (the UDG, for example) to turntables with mechanical, optical, and other read-out systems are currently being produced both domestically and abroad. Manufacturing them is complicated and requires a great deal of labor and a great deal of expensive material.

The simplest devices to manufacture and the most reliable to operate are those based on direct indexing, i.e., indexing by an index pin through an indexing disk that is attached to a faceplate. The shortcoming of this type of device is the small number of positions, depending on the diameter of the indexing disk, on the face of which the indexing elements (holes, teeth, etc.) can be made.

Specialists from the Gomel Production Planning and Research Institute, working in collaboration with the production association Izmeritel [gauge] and the Gomel Polytechnic Institute, solved the problem of increasing the number of positions of indexing devices based on direct indexing without increasing the disk diameter. They did this by supplementing the disk's indexing elements with elements of an external divider, for example, an index pin. In this case, besides clamping by an index pin, the angular (in rotary devices) or linear (in linear devices) quantities are divided into smaller quantities.

This principle makes it possible to expand the number of positions up to infinity on one and the same indexing device with mechanical read-out as well as divide any quantity (for example, into minutes and seconds on rotary devices and into tenths, hundredths, and thousandths of a millimeter on linear indexing devices) independently of the dimensions of the device and without any further modification. Furthermore, of the entire array of rotary indexing devices currently manufactured, it will be possible to manufacture only four to five type sizes, e.g., those with faceplate diameters of 120, 200, 280, 360, and 750 mm, and still perform the same work that is done by existing devices, but at a substantially lower cost and with a substantial savings of metal.

Linear indexing devices are distinguished by the overall dimensions of their table. The simultaneous use of high-precision rotary and linear indexing devices expands their technological capabilities significantly. In this case, a high-precision movable coordinate turntable is being produced. The centralized manufacture of a movable coordinate table and a rotary indexing device will result in a unification of about 80 percent.

The indexing device (Figure 1) consists of a casing (2) in which a faceplate with attached pinions (5) rotates. The pinions include indexing elements in the form of teeth. The casing is mounted on an angle piece that makes it possible to place the turning device in a horizontal position and use it as a turntable (Figure 2a) [not reproduced] or in a vertical position by using the indexing device as an indexing head (Figure 2b). The casing includes openings under the sleeve (3) (see Figure 1) through which the indexing elements of one of the index pins (4) are brought into contact with those of the pinion. The number of degrees the faceplate is turned is read according to a scale on the faceplate's casing. The sleeves (3) and index pins (4) are used to read the minutes and seconds.

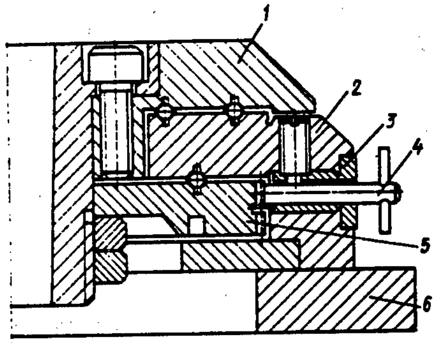


Figure 1

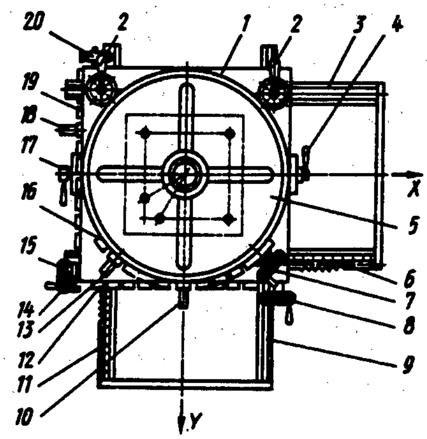


Figure 3

The rotary turntable (Figure 3) consists of a casing (1) that moves in the direction of the X and Y axes along the respective gear racks (3), (6), (9), and (11), with (6) and (11) being indexing gear racks. The turning of flywheels (8) and (15) effects the motion along the gear racks (6) and (11). The motion in millimeters is read according to a rule on the gear racks (6) and (11) and the indicators (14) and 20). Tenths, hundredths, and thousandths of a millimeter are read by using the index pins (10) and (18) and sleeves (12) and (19). The locking motion of the carriage along the X and Y axes is effected by the turning of the knobs (2) and (17). A rotary indexing device with a faceplate (5) is built into the casing (1). The faceplate is turned by a flywheel (7), and the number of degrees turned is measured according to a scale on the faceplate's casing. Minutes and seconds are read by the index pin (13) through the sleeve (16). The faceplate is locked by turning a knob (4).

Since the read-out system becomes more complex (from mechanical to electronic) as the precision of the read-out on the indexing devices increases, the mass, overall dimensions, and the labor intensity and cost of manufacturing the existing analogues generally increase as well. The difference between the proposed indexing devices and those that now exist lies in the fact that increasing the precision of the read-out will not depend on the overall dimensions of the device itself. On the smallest indexing head with a faceplate diameter of 90 mm, for example, it is possible to obtain a precision that is no less than that of a turntable with an optical indexing device. But manufacturing it will require only a tenth of the labor and metal currently required.

The proposed indexing devices require 40 to 50 percent less metal and labor to manufacture as compared with existing devices. The labor productivity of servicing the proposed devices is increased. The proposed indexing devices make it possible to use movable coordinate turntables (in the absence of jig boring machines) in agricultural workshops, repair and machine shops, and research shops and sections. When a movable coordinate turntable is combined with an electric drill, it may be used for personal use or in flying workshops, for example, to repair technology under field conditions, and in workshops at educational institutions. The indexing devices have the following technical data:

Technical Data (Numerators contain data for the indexing heads and turntables, whereas denominators present data for the coordinate tables.)

Faceplate diameter, mm	120	200	280
Faceplate's turning angle, degrees	360	360	360
Precision of the faceplate's positioning:			
Angular (when there are 60 indexing pins)	60	15	10
Linear along the X and Y axes, mm	-/0.01	-/0.01	-/0.001
Overall dimensions of device (l x w x h), mm	(150x225x280) (300x400x500)	(190x200x300) (300x400x500)	(80x92x120) (160x185x220)
Mass, kg:			
Allowable product	5	20	30
Device	3/10	18/54	25/80

Benefits of Collective Contract in Moscow's Cement Industry Discussed

18610072 Moscow BETON I ZHELEZOBETON in Russian No 8, Aug 88 pp 2-3

[Article under the "Decisions of the 27th CPSU Congress Into Life!" rubric: "To Manage in a New Way"]

[Text] The further intensification of the economy, the retooling of all branches of industry, and the implementation of social programs are all largely dependent upon the state of affairs in major construction. That is why in the area surrounding Moscow the fundamental problems in this branch of the national economy are receiving a great deal of attention. In the past few years the structure of the branch's management has been improved, and construction organizations and enterprises have made a gradual transition to a collective contract, full cost-accounting, and self-finance. These measures have all had positive results.

Thus, having fully deployed socialist emulation behind the worthy meeting of the 19th All-Union Party Conference, the toilers of the construction industry in the Moscow oblast have made positive movements in developing the economy and increasing its efficiency during the first quarter. The industrial enterprises of the construction complex have increased and fulfilled the first-quarter quotas for the production of cement, wall materials, and asbestos cement pipes and couplings. The plan quotas for clinker production have not been fulfilled. The Podolsk and Shchurovsk cement plants have not fulfilled the production plan.

During the first quarter, 1,161,000 tons of cement and 615,000 m^3 prefabricated reinforced concrete structures and products were produced in this oblast. Thanks to state centralized capital investments and resources form enterprise funds, a total of 296.8 million rubles worth of fixed capital was put into action, which is 11 percent higher than in the first quarter of 1987. As a whole, the quarterly plan for the oblast was fulfilled by 153 percent, and 516.8 million rubles worth of capital investments were assimilated.

The amount of contract work that the construction and assembly organizations of the Main Administration of Construction Work in the Moscow Oblast [Glavmosoblstroy] performed with their own forces increased by 7 percent, and labor productivity increased by 7.5 percent. The entire increase in the volume of operations in the Glavmosoblstroy was due to an increase in labor productivity. The Administration of Construction Work in the Zhukovskiy Oblast, the No. 2 and No. 18 Moscow Oblast Construction [Mosoblstroy] trusts, and the No. 18 Moscow Oblast Agricultural Construction [Mosoblselstroy] trust completed their contract work plans successfully.

The builders of the Balashikhinskiy, Voskresenskiy, Yegoryevskiy, Zagroskiy, Kolomenskiy, Krasnogorskiy, Mozhayskiy, Orekhovo-Zuyevskiy, and Ruzskiy rayons all fulfilled their plans for introducing residential structures.

It should be noted that in the region the use of intraproduction reserves has been weak, the transition to two- and three-shift work routines has been slow, and extensive losses of work time have been tolerated. In many trusts, specialized assembly administrations [SMU], and PMK [not further identified], the collective contract is not providing its obligatory yield, and the quality of work being output is low. There is still a lot of long-term construction within the oblast's territory.

Complex problems remain to be solved by the construction and plant collectives of the Main Administration of Construction Work in the Moscow Oblast and the Main Administration of Building Materials in the Moscow Oblast during the 12th Five-Year-Plan. There activity at the present time may be characterized in terms of the search for and introduction of progressive forms of labor and production organization, the creation of modern efficient designs and expansion of the areas in which they are used, improvement in industrial construction methods, development of bases for making up production and technological sets, and an increase in the containerization and packaging of construction shipments.

As practice has shown, the expeditious introduction of progressive forms of labor organization and stimulation plays an important role in the matter of increasing production and scientific-technical potential. The Mansurovskiy Open-pit Mine Administration, Pavlovo-Pasadskiy Brick Plant, Dmitrovskiy Wood Processing Plant [DOZ], and Sychevskiy Ore Enrichment Combine, among others, are thus operating successfully under conditions of a collective contract.

Improving the entire economic operation of an enterprise is one of the important conditions for a successful transition to full cost-accounting. It is common knowledge that beginning 1 January 1989 the main Administration of Construction in the Moscow Oblast and Main Administration of Construction Materials in the Moscow Oblast will switch over to full cost-accounting, self-finance, and self-support. Some structural subdivisions are already operating under the new management conditions. In general, the restructuring of the construction complex is being based on the collective contract. In many organizations where the attitude toward all of this has been informal and thoughtful, full cost-accounting has been almost fully achieved. However, in a number of organizations where the command style of administration has not been dismissed, the collective contract has not appeared in full force. These are the exact organizations that did not achieve their last year's planned increases in volumes of work done, output, and profit.

In the next few years the enterprises of the Main Administration of Building Materials in the Moscow Oblast will have to increase their production of reinforced concrete one and a half times. At the same time, they will have to increase the technical level of their production and improve the quality of products manufactured. This requires modernizing equipment and updating most production lines. The collectives of the Bunkovskiy Pilot Plant for the Production of Components for Village Homes, the Stupino Cellular Concrete Plant, the Domodedovo Building Materials and Structures Plant, and the Kilinskiy Building Components Plant have all had definite success in this direction. A rotary production line to produce concrete mosaic tiles, which is in short supply, is currently being developed in cooperation with machine building specialists.

Accomplishing the tasks of increasing the production of building materials in the central administrative board involves switching enterprises over to new forms of labor organization. The activity of the Butovo combine in a lease contract and the creation of the Berezka [little birch] cooperative in the Zagroskiy rayon have thus been one effective way of strengthening the economies of these enterprises.

In the beginning of the year, the Butovo Building Materials Combine leased its own low-profit enterprise. The lease was for 8 years. An agreement was concluded with the central administrative board. According to this agreement, the combine's collective rents all the machine tools, equipment, and locations. Specific payments to the central administrative board were established. The collective uses the amount remaining after squaring accounts with the central administration to update production and for social development.

This initiative has received support at other enterprises of the central administrative board. Workers at the Stroypolimer [Polymer Construction] Plant followed the example of the workers from Butovo. The plant's collective will henceforth choose the directions of its activities independently. They have thus decided to begin the production of scarce finishing materials, essentially a new product, for the realization of which they have received the right to establish contract prices.

The Stroypolimer collective has been charged with extensive tasks. In the next few years they will have to raise their production of linoleum from 4.5 to 10.5 million meters per year and increase their production of sealing compound and sealant 2.5-fold. If the enterprise's current fixed capital, which has paid for itself many times over, amounts to 7 million rubles, then by 1995 more than 20 million rubles must be directed toward developing production. The collective must earn this capital itself.

The plant's collective now also has this capability. Henceforth, all above-plan profit will go to the plant money box. Workers and engineering and technical personnel alike are interested in full cost-accounting income.

It should be noted that within several months of working on practically the same material foundation but under the new economic operating methods the plant workers have obtain a significant profit. Labor productivity increased more than 20 percent, and production costs decreased noticeably. Labor and production discipline have been strengthened. Work on the wide-scale use of scientific-technical progress, rationalization, and invention has been activated. The labor collective's effect on all aspects of in-plant life has intensified. Thus, the labor collective's council proposed and adopted a completely unexpected proposal for economy. They decided not to sell their linoleum production wastes, several thousand tons of which have accumulated in the enterprise over long years. Instead they have decided to buy it from other enterprises at a similar price. The laborers at Stroypolimer have thereby ensured themselves against interruptions in polyvinylchloride shipments. Furthermore, the product produced from inexpensive wastes has a low cost. This is an inexhaustible profit potential. Waste salvaging is currently being set up at the plant.

The intraproduction cooperatives that have been created at the plant process a large portion of these wastes. These cooperatives have been created at the workers' initiatives. The cooperatives have different profiles. One of these, Gidroizolyatsiya [water proofing], consists of 20 individuals. This cooperative is currently working on producing pure polyvinylchloride. In the future it plans to produce consumer goods, for example, decorative floor tile.

The members of another cooperative (called Polimer) fill orders from residents of nearby rayons to lay linoleum flooring in apartments. When they receive orders, the cooperative members send them to a shop where linoleum wastes are used to manufacture floor coverings with the required dimensions. The in-plant cooperative Neva builds and repairs residential structures. All necessary materials are acquired at the plant.

It should be noted that a collective contract was introduced at the plant about a year and a half ago. After taking that step, the plant workers were able to go farther and lease the entire enterprise. Democratization in the collective, social forms of self-management, and the elimination of egalitarianism all became a reality here.

The plant workers understand well that the activity of Stroypolimer and its successful operation are accelerating the solution of many social problems. Construction of a new club, sports complex, youth dormitory, and two multiapartment dwellings are thus slated for the plant settlement in the near future.

The collective contract has, in many respects, paved the way for success in work to change the construction organizations and enterprises over to full cost-accounting and self-finance. This progressive form of labor organization and stimulation has been the fertile ground for arousing the interest of the entire collective in end results.

Thus, at the Dmitrovskiy Wood Processing Plant in Balashikha, the collective contract has encompassed all stages of production, beginning with workers in auxiliary services to employees in administrative departments. All of this has been geared toward achieving a positive end result. In 1987 the production volume increased 18 percent here. The plant does not currently have any complaints about its product.

Workers at the Dmitrovskiy Wood Processing Plant, especially pieceworkers, have a material interest in fulfilling the plan quotas with the least expenditures. Thus, the brigade of the woodworking shop, which is headed by V. M. Morozov, concluded an agreement with the administration stipulating production volumes for the month, quarter, and year. Wages were calculated for this volume with an allowance for the planned number of workers. If the brigade meets the conditions specified in the mutual agreement, the full wage fund remains in the subdivision. They were successful in economizing raw material. Indeed, half of the cost of the lumber saved also stays in the brigade.

A new woodworking shop was introduced at the Dmitrovskiy Wood Processing Plant last year. The workforce had to be expanded to 120 persons to make it operational at full capacity. The situation changed with the introduction of a collective contract. Only 46 persons were needed to work in the new shop. Discipline became noticeably stronger at the plant, and the workers became more willing to master their occupations than before. Mutual assistance became the norm in relations between workers.

Other construction organizations in the rayon should follow the woodworkers' example.

In the Moscow oblast, to accomplish the tasks set to be accomplished by the year 2000, each family in each individual apartment or house made the respective calculations and determined the directions to be taken by the council and economic organs. A housing program was adopted in 1987. Plans call for bringing the level of those members of the population having individual apartments up to 85 percent in the first stage of the program, i.e., by 1990.

The housing program adopted is being implemented in 14 cities and rayons in the oblast. Intensive construction is underway in the Ramenskiy rayon, where they are ahead of the quotas established. Residences having a total area of 12,000 m^2 over the plan have been put into use.

The oblast has the resources for accelerating the pace of residential construction. Analysis shows that residences having a total area of 2.9 million m^2 can be made available for use this year. Above all, reaching this indicator requires increased accountability on the part of the directors of the construction organizations. In the past 2 years only 90 percent of the resources allocated for residential construction were used.

Further acceleration of the pace at which residential structures are assembled is impossible unless the industrial residence construction base is developed. By the end of the 12th Five-Year-Plan, the capacity of the enterprises in the construction industry should be increased by a total are of 380,000 m^2 each year. Half of this amount will result from redesigning and expanding residential construction combines that are already in existence. it has become necessary to create residential construction combines for the oblast's western zone at once.

Accelerating the tempo of construction in the oblast requires retooling the construction industry's base and building materials' base. The resources that have been allocated for the construction complex to develop its own base are systematically not being fully assimilated. As quickly as possible, there must be very decisive measures to redesign and retool prefab housing construction combines and achieve a sharp increase in the number of improved-series homes produced for the settlement and in the amount of components produced for multistory homes in the oblast's cities.

In accordance with the resolution of the session of the oblast Council of People's Deputies, it has been decided to erect new home construction combines in Solnechnogorsk and Pushkino that have the capacity to produce residential structures having a total area between 100,000 and 120,000 m^2 per year, to produce a combine in Shatura having the capacity to produce residential structures with an area of 40,000 m^2, and to increase the production volumes of the residential construction combines currently existing in Elektrostal by 30,000 m^2. This will make it possible to bring the capacity for prefab home construction in the oblast as a whole to a total area of 2.2 million m^2 per year.

In the next few years it will be necessary to almost double the production of precast reinforced concrete and mortar. The retooling of the trusts' material and technical base has been planned in order to accomplish this. The trusts are now producing 270,000 m^3 of reinforced concrete, 3.3 million m^3 of concrete and mortar, 20,000 tons of fittings, and 1.2 million tons of asphalt per year. If the Main Administration of Construction in the Moscow Oblast is to complete their contract work amounting to a total of 1.35 billion rubles, 500,000 m^3 of reinforced concrete, 5.5 million m^3 of concrete and mortar, 50,000 tons of fittings, and 2 million tons of asphalt will need to be produced each year.

The Main Administration of Construction in the Moscow Oblast and Main Administration of Construction Materials in the Moscow Oblast have recently established a program calling for the expansion of existing plants as well as the bases of trusts that use high-productivity equipment to manufacture reinforced concrete structures and products, for the redesign and retooling of 18 mortar units, and for the introduction of automatic control of the component-metering systems in Kolomna, Ozery, Lukhovitsy, Yegoryevsk, Podolsk, and other cities. Plans have also been made to use new, efficient technologies to update 14 asphalt concrete plants in Zaraysk, Domodedovo, Zagorsk, Pushkino, and other cities.

To accomplish the tasks that have been established for the area surrounding Moscow, an entire set of educational-political and economic measures is being implemented, and monitoring of the introduction of the collective contract and full cost-accounting is being increased. The political and economic instruction of personnel is being organized everywhere. This approach is making it possible to effect the transition to economical operating methods without great outlays.

UDC 061.4:004.18

"Resource Conservation'88" Exhibition

18610107a Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 8, Aug 88 pp 31-32

[Article under the rubric "At the USSR Exhibition of Economic Achievements": "Resource Conservation'88"]

[Excerpts] In the "Basic Directions for the Economic and Social Development of the USSR for 1986 to 1990 and for the Period to the Year 2000" the necessity is pointed out of the consistent strengthening of economic procedures, representing one of the most important factors of the intensification of production and the transformation of resource conservation into a decisive source of satisfaction of the growing demands of the national economy. The tasks were set of reaching the point by the year 2000 where the 75 to 80 percent growth in the demand for fuel, energy, raw materials and other materials has been satisfied by economizing on them, and of reducing the national income's energy intensiveness by a factor of not less than 1.4 and its metal intensiveness almost twofold.

The importance was stressed of the total utilization of natural and physical resources, of the maximum elimination of losses and inefficient consumption, and of the extensive involvement in economic turnover of secondary resources, as well as byproducts.

The "Efficient Use of Physical Resources in the National Economy" - "Resource Conservation'88" interbranch exhibition, which opened at the USSR VDNKh [Exhibition of Economic Achievements] in April of this year, acquainted visitors with the work results and experience of 40 ministries and departments and a number of republics relating to the implementation of the broad resource conservation program in the country.

It was demonstrated in parts of the exhibition in specific exhibits, on display boards and with slides how the resource conservation policy is being implemented in the 12th Five-Year Plan period by the following means: the development of progressive forms of material and technical supply and of production services that ensure economizing in the national economy; the improvement of the processes of managing the supplies of commodity stocks and equipment at the country's enterprises; the provision of the introduction of research and planning work for the solution of resource conservation problems; the organization of the total utilization in the national economy of manufacturing and consumption waste; the organization of the development and implementation of regional and branch "Saving" programs; and the introduction into production of progressive consumption norms for raw materials and other materials, resource conservation processes and high-efficiency and economical materials, equipment and devices.

The exhibition was graphic evidence of how the advanced know-how of the best resource conservation teams is being studied, systematized and propagandized.

The effective role of the integrated "Saving" programs, a tool for the strengthening of resource conservation in the national economy (cf. fig 1), was stressed at the exhibition. Such programs have been developed and are being implemented in all republics and sectors of the national economy. The savings of physical resources during the 12th Five-Year Plan period must equal not less than 35 billion rubles. The "Saving" programs have been called upon to accomplish this most serious aim on the state-wide, branch and regional scales. Their role is to coordinate and supervise resource conservation.

The exhibition emphasized ways of solving the resource conservation problem based on an effective counter-expenditure mechanism: utilization of the latest equipment and technology (a saving of 70 to 75 percent), and the involvement in production of secondary resources and above-plan stocks (25 to 30 percent).

The coordinator of all the work relating to economizing on physical resources in the country is the USSR Gossnab—one of the principal organizers of the exhibition, which has been assigned the task of the economic supervision of resource conservation.

The problem will be solved of the further freeing of primary raw materials and other materials because of the use of secondary resources for the national economy (12 billion rubles in 1985, 15 billion rubles in 1990 and 23 to 25 billion rubles in the year 2000).

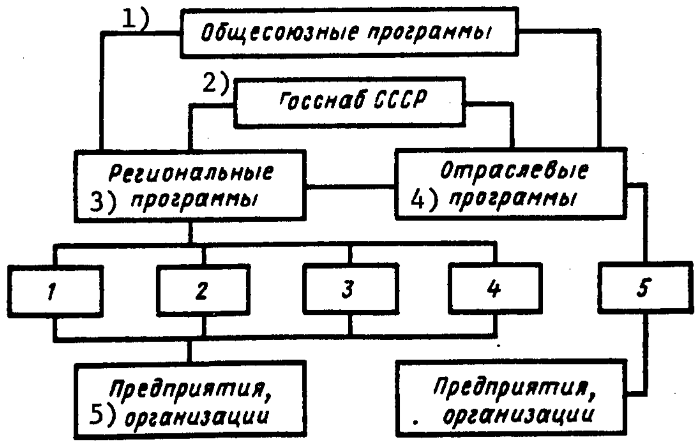


Figure 1. Chart of Coordination and Economic Supervision of Resource Conservation Based on "Saving" Programs
Key: 1. Central committees of communist parties of union republics, party kray committees and oblast committees 2. Councils of ministers of union and autonomous republics 3. Executive committees of Council of People's Deputies 4. Territorial organs of Gossnab [State Committee for Material and Technical Supply] 5. USSR ministries and departments

The state program for the utilization of the most important kinds of secondary resources in the USSR's national economy for 1986-1990 and for the period to the year 2000 calls for increasing the utilization of secondary raw materials more than twofold while bringing their share of the consumption of the most important kinds of raw materials and other materials in the national economy to 18 to 20 percent (by the year 2000).

The exhibition demonstrated ways of improving the utilization of secondary resources and production waste, of developing production capacities for waste processing, and of further improving the organization of the collection of secondary raw materials.

One could become acquainted at the exhibition with the developed list ofservices being rendered by organizations of the USSR Gossnab, the extent of the saving from the rendering of which will equal more than 50 million rubles by 1990. Four hundred and sixty-six shops and sections representing total annual services of 1.7 million tons worth have been created in the USSR Gossnab system for rendering production services to users. One hundred and ten rolling centers have been formed and are functioning, with a total stock of 64.3 million rubles worth. The preparation of products for the manufacturing consumer is making it possible to reduce waste threefold and to provide the following savings: of 10 percent for rolled ferrous metal products, of 15 percent for raw materials for the chemicals and papers industry, and of 5 percent for cable products (of the amounts of products being subjected to prior preparation).

More than 100,000 users—enterprises and organizations of various ministries and departments—are using the production services.

The saving from the rendering of services of a production nature will grow almost sevenfold by 1990 as compared with 1980. It was stressed at the exhibition that the expediency of this kind of arrangement is defined not only by a saving of physical, but also of labor and financial resources. Besides, in the process the quality of the supplying of consumers is improving and working conditions are improving, which is directly associated with the rise in the level of the mechanization and automation of operations relating to the prior preparation of products for the manufacturing consumer.

The exhibition told about the development and spreading of progressive forms of supply—long-term direct ties, guaranteed total supply, and wholesale trade—which will be developed more actively in the 12th Five-Year Plan period.

Considerable work was done by the procurement organizations of the gossnabs of union republics during the years of the 11th Five-Year Plan period, relating to the improvement of organizational forms for the procurement of secondary raw materials and to increasing the amount of this procurement. However, this work requires further improvement and expansion.

The specific tasks facing the USSR Gossnab relating to the further improvement of progressive forms of supply and to expansion of the use of secondary raw materials were pointed to at the exhibition. Exhibits were presented of products made from secondary raw materials, and the basic directions for the use of waste paper were revealed (the level of its use must equal 60 percent). A selection of various kinds of cardboard and paper and of packaging materials was presented.

The intent is that by the year 2000 the extent of the use of waste paper will equal up to 85 percent of annual resources, which will free not less than 200 million cubic meters of timber, to the tune of four billion rubles worth.

The solution of problems relating to the processing of polymer raw materials in the 12th Five-Year Plan period was demonstrated. The intent is that the use of worn-out tires in the 12th Five-Year Plan period will make it possible to free more than 400,000 tons of synthetic rubber, to the tune of 200 million rubles worth.

The extent of the collection of waste paper grew by 20.5 percent in 1985 as compared with 1980, of worn-out tires by 8.6 percent, of broken glass by 23.1 percent, and of secondary polymer raw materials by 81.5 percent. Such an increase in the amount of procurement of principal kinds of secondary raw materials without an increase in the number of personnel involved in procurement work is possible, as stressed at the exhibition, because of improvement of the planning of the collection of secondary raw materials and the strengthening of the material and technical base of production-and-procurement organizations on account of the introduction of new production capacities and the furnishing of them with modern mechanization facilities.

Work relating to economizing on physical resources and to the implementation of resource conservation trends in the development of new technology, as well as of processes for the introduction of this technology into production in the fuel-and-energy, metallurgical, machine building, construction, chemicals-and-lumber and transportation complexes, was demonstrated extensively at the exhibition.

Examples of successful work relating to resource conservation at enterprises of certain branches of industry are presented below. [passage omitted]

UDC 621.9.048.3:681.3.068(430.2)

Flexible Automation Conception

18610107b Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 8, Aug 88 pp 38-40

[Article by V. I. Kharkov, engineer, under the rubric "Technology Abroad. 'GDR in Moscow' Exhibition": "Flexible Automation Conception"]

[Text] The machine tool building and machine tool and tool industries of the GDR's national economy have traversed a great and glorious road in their development. The development of these industries is oriented primarily toward the integrated program for the scientific and technical progress of the CEMA countries to the year 2000. The main goal of this program is the improvement of production efficiency based on the international socialist division of labor. Equipment and control systems for flexible manufacturing modules, flexible manufacturing systems and computer-controlled automated sections; new types of industrial robots and robotic systems; and new high-efficiency technologies must develop at especially accelerated paces.

The business ties between the USSR and GDR in the machine tool building field have a history of many years. Tens of thousands of various machine tools have been shipped to our country, including special machine tools for the bearing industry, knee-type milling machines, various presses, casting machines, and also lines for grinding and lines for the manufacture of preserving containers.

About 80,000 workers, engineers and other employees work in the GDR's machine tool building industry. The main consumers of the industry's products are the FRG, Italy, France, England, Japan, the USA, Sweden, India and other countries.

Present-day demands on the metal working industry caused by the worldwide trend toward an increase in the range of products being produced have given rise to the trend of the development of manufacturing systems for the manufacture of products with high productivity and high-quality machining. This is being aided by the extensive introduction of the automation of manufacturing processes. The GDR's machine tool building industrial combines are developing their own versions of the flexible automation of metal working based on machining centers. For instance, the F. Hekkert Combine (Karl-Marx-Stadt) is working on the development of equipment for the machining of base members, the October 7 Combine (Berlin) for the machining of parts of the body of revolution type, and the H. Warnke Combine (Erfurt) on the fabrication of parts from sheet materials.

The flexible automation conception has been adopted in the GDR as the basic direction for the development of metalworking equipment. The conception has its roots in an immediate reaction to the ever higher economic and technical demands of customers for the development of high-productivity modular manufacturing systems requiring few people to attend to them. The modular structure of the manufacturing process takes account of existing particular features at enterprises: manufacturing volumes, productivity-increasing engineering, cost reduction, improvement in product quality, improvement of working conditions, and shortening of the time it takes for introduction. The extension of the automation of manufacturing processes—the development of FMSs [flexible manufacturing systems]—is the most reliable way to achieve these goals, because it makes it possible to improve production organization, increase the length of the work time involving few people, reduce the size of a batch of products, and change from mass and quantity production to small-lot production.

The use of FMSs produces a significant saving.

Twelve FMSs, including FMSs for machining base members and parts of the body of revolution type for electric motors, were developed and manufactured in 1984-1986.

The cost-per-production-volume ratio can be improved even further by the gradual improvement and expansion of available manufacturing systems, because the costs of control and materials handling are relatively low up to an FMS of a certain size, which will result in a reduction in the cost per unit produced. The increase in labor productivity from using an FMS as compared with various initial levels is illustrated in fig 1.

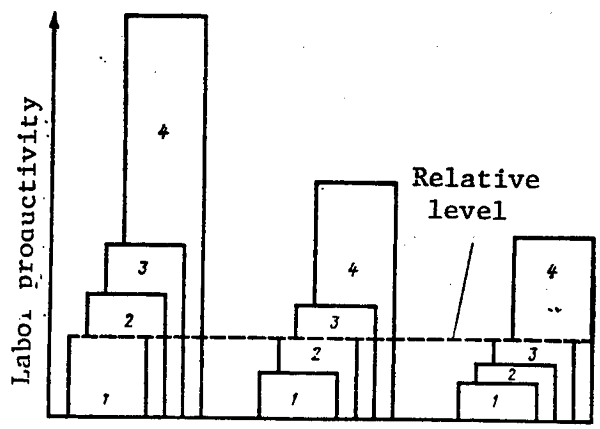


Figure 1. Growth in Productivity When FMS Is Used
Key: 1. Ordinary machine tools 2. Mixed equipment (ordinary machine tools + NC machine tools, 50/50 percent) 3. NC machine tools 4. Flexible manufacturing system

The diagram shows that, as compared with ordinary machine tools, the use of an FMS increases labor productivity fourfold; as compared with mixed equipment (50 percent ordinary machine tools and 50 percent NC machine tools), labor productivity is increased twofold, and 1.3-fold as compared with NC machine tools.

A flexible manufacturing system consists of three principal parts: a machining system, a materials flow system and an information flow system.

The machining part is comprised of NC machine tools, machining centers and other equipment, as well as systems for automatic quality control and for monitoring the course of the process (three-coordinate feelers and single-coordinate gauges are used for quality control and instruments for measuring the current of the main drive and feed drive motors, devices for diagnosing tool breakage—feelers that contact the tool—and photographic cameras are used to monitor the process).

The materials flow system consists of flow routes for parts and tools, as well as fixtures, instrumentation, auxiliary equipment and chips. The principal materials flow equipment is inductively controlled materials handling trucks and trucks that move along rails, racks of the tower type with stackers, devices for gripping parts and transferring them, and equipment for cleaning and removing chips.

The information flow system is the foundation of flexible manufacturing. Software developed according to the modular principle is used for controlling the individual subsystems, as well as for the optimal loading of machine tools. The information flow system's structure is based on two subordination principles: functional and hierarchical. Such an information retrieval system, called a "modular program control system for FMSs," was developed by the Scientific Research Institute of Machine Tool Building in Karl-Marx-Stadt.

The software package is divided according to purpose (fig 2) with the distribution of functions at four levels. The following principal production process requirements are fulfilled in a modular software system:

The distribution of blanks by machine tool.

The ensurance of the readiness for operation of machine tools, pallets and materials handling and storage equipment and the control of them when an order is issued.

The assignment and control of auxiliary processes at the stages of the preparation and machining of parts.

The management, control and registration of basic data for the scheduling and implementation of production processes.

The assignment and distribution of control data to NC machine tools, machining centers, industrial robots, etc.

The exchange of data concerning the environment is organized so that each data element enters only one interface. Internal data exchange is performed by means of a standard interface.

Flexible manufacturing systems have been developed for using the computer facilities of the Robotron Combine (GDR) with standard interfaces. The basic computer is a Robotron A 6402 and the data registration system is the Robotron A 6422 with an MUX K 8523 interface for the connection of NC units produced by the Numerik Karl Marx People's Enterprise. Programs have been developed primarily in FORTRAN IV.

The information (management) system occupies a central place in an FMS (fig 3). This system consists of many programs, the extent of which depends on the kind and number of units of equipment, the materials flow and the kinds of parts machined. The programs are configured into groups (according to functional purpose).

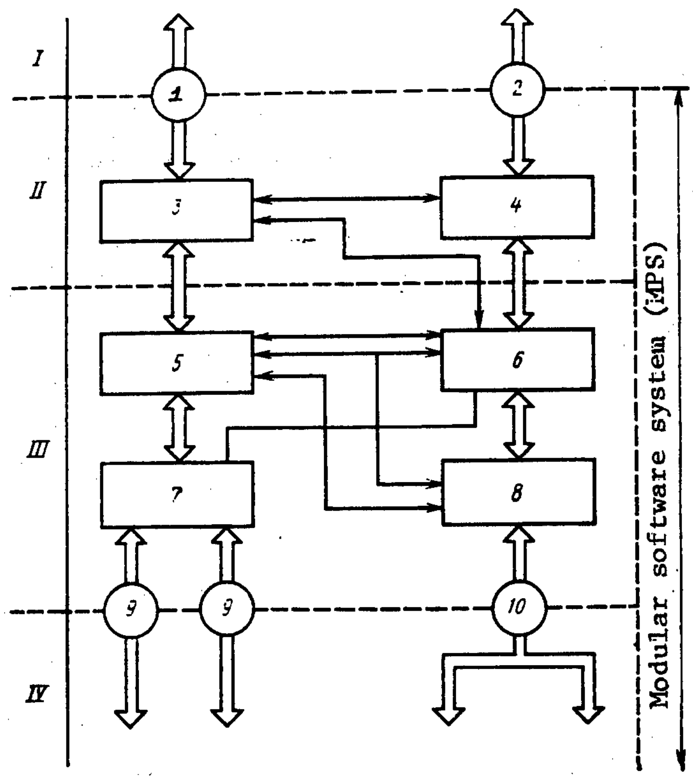


Figure 2. Modular Software System Structures With Basic Information Links

Key: I. Intraplant scheduling II. Supervision level III. Control system level IV. Machine tool and instrument control system level 1. Intraplant scheduling 2. Machine programming 3. Group loading of workstations 4. Control data archive 5. General readiness for start of machining process 6. Disposition of fixtures, tools and instrumentation 7. Coordination of materials handling and storage 8. Control of workstation 9. Materials handling control systems 10. Control system for NC machine tools, machining centers and industrial robots

The groups are:

Control of workstation loading programs. The principal parameters for the machining of parts are found in this program. Orders for the fabrication of parts, operations scheduling assignment for each workstation in the accepted sequence.

The control element archive has a database for the control of machining operations, e.g., registering the tool requirement.

Machining control—schedules the loading of workstations, taking into account the basic data of the machining schedule, and sets times (the start and finish of working operations). Reacts automatically to violations. This system is to be considered the FMS control center, because it controls, registers and monitors the synchronous course of all processes over time.

The control of pallets, clamping devices and sets of tools—has monitoring facilities and issues orders, e.g., for tools. The materials handling system is switched on and the required tools are supplied to the workstation named in response to an order. After the end of the working operation a signal is issued and the tools return for preparation for new use.

Materials handling system and storeroom control. Stocks of materials and transfer and materials handling operations are controlled. Orders received from the machining control system and from the pallet control system are transferred to the materials handling and storage subsystems for execution.

Workstation control. Data for controlling the working process are prepared from the control data archive based on prior specifications. The results of monitoring the process are received by the machine tool's NC unit for execution.

By using flexible automation systems for controlling FMSs it is possible to increase very significantly labor productivity, product output efficiency, and the effectiveness of the improvement of an enterprise's operating results.

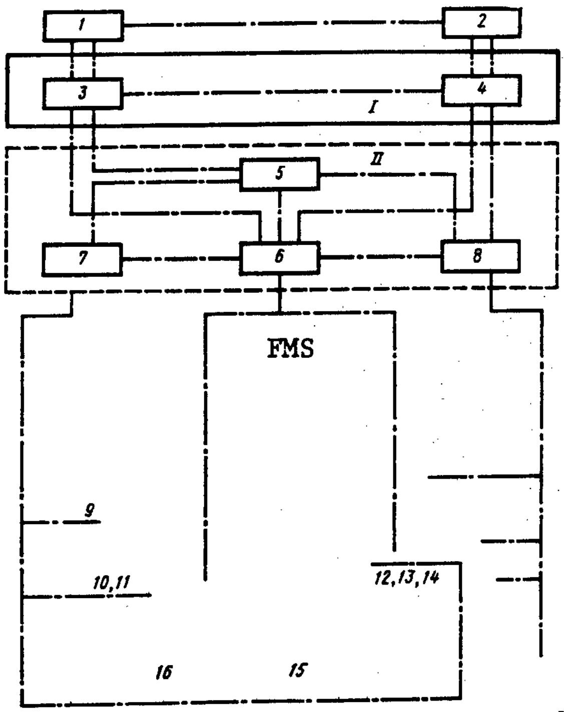


Figure 3. Chart of Control of Production at Automated Enterprise

Key: I. Scheduling of production systems 1. Production scheduling system 2. Production preparation system 3. Workstation group loading system 4. Control data archive system II. Production scheduling 5. Machining control system 6. Pallet control system 7. Materials handling control system 8. Workstation control system 9. Storeroom 10. Materials handling system 11. Machining center NC units 12. Preliminary tool set-up 13. Materials handling system 14. Control computer for pallet flow and machining control systems 16. Main control data computer

This is achieved mainly because of the system's flexibility, which makes it possible to readjust rapidly for the machining of new parts, and because of the linking of machining equipment with the materials flow and information management systems, and because of elevation of the level of production scheduling, organization and supervision.

The use of the flexible automation conception at enterprises is producing a considerable saving, i.e.,:

A 50 to 70 percent shortening of the time it takes for parts to pass through.

A 20 to 50 percent shortening of the time it takes to machine parts,with an improvement in quality.

A 40 to 60 percent increase in equipment in-service time.

A 200 to 400 percent shortening of the time it takes for introduction, with increased productivity.

A 30 to 70 percent saving of manpower.

A 20 to 50 percent saving of machine tools and equipment.

A 20 to 40 percent reduction in production space required.

A 10 to 20 percent reduction in rejects and saving of materials.

According to the data of a firm that produces FMSs, the percentage of time it takes to prepare and change parts on NC machine tools equals 18 percent, approximately 12 percent in machining centers, and just 4 percent in an FMS. The percentage of downtime for organization reasons equals 8 percent on NC machine tools and just 2.5 percent and less in an FMS.

One can become acquainted in greater detail with the flexible automation conception at the "GDR in Moscow" exhibition in pavilion No 1 at the USSR VDNKh [Exhibition of Economic Achievements] from 16 September through 9 October of this year.

Eighth All-Union "Efficiency, Quality and Reliability of Man-Equipment Systems" Symposium

18610112 Leningrad SUDOSTROYENIYE in Russian No 8, Aug 88 pp 42-45

[Article by V. V. Yegrafov, G. A. Zakharov and P. I. Paderno]

[Text] The Eighth All-Union "Efficiency, Quality and Reliability of Man-Equipment Systems" Symposium was held in Tbilisi in the spring of 1987. The available results of studies and problems were discussed at it, and the 20-year development of this scientific trend in the USSR was summed up.

The discussion of new scientific and practical results of work on the problem and of ways of incorporating them in the practice of the designing and use of man-equipment systems (SChTs) was set as the symposium's main goal. About 200 scientists and leading practical worker specialists from more than 30 cities in the country took part in the symposium's proceedings.

Three plenary sessions and a business meeting of users and developers were held at the symposium and six sections worked in the following main trends:

The formalization of ergonomic knowledge and data on the efficiency, quality and reliability of man-equipment systems.

The employment of the methods and facilities of artificial intelligence for improving the efficiency, quality and reliability of man-equipment systems.

The evaluation of the efficiency, quality and reliability of man-equipment systems.

The optimization and designing of man-equipment systems.

The automation of ergonomic support for the development and use of equipment based on indicators of efficiency, quality and reliability.

The automation of the storage and processing of information relating to the efficiency, quality and reliability of man-equipment systems.

Basic-research and summary papers were given for each trend and exhibition stand materials were presented, and the achievements and immediate objectives of the development of these trends were discussed.

At the first plenary session A. I. Gubinskiy presented a paper titled "Current Problems of the Scientific Trend 'Efficiency, Quality and Reliability of Man-Equipment Systems.'" He showed that the main prospects for the development of this scientific trend involve the automation of ergonomic support for the development and use of complex man-machine systems for various purposes.

In a paper by V. A. Mozin and P. I. Paderno titled "Twenty Years of the Scientific Trend," a detailed analysis was given of the formation of this scientific trend in our country, a number of problems were pointed out, methods of solving which have been broadly introduced into the national economy, and the necessity was stressed of broadly introducing the achievements of modern informatics in ergonomic work.

USSR Pilot-Cosmonaut P. R. Popovich presented a paper titled "Role of the Human Factor in Astronautics." He enumerated a set of questions relating to man's growing role at today's stage of the development of domestic astronautics and singled out as the main problem that of the distribution of functions between the cosmonaut and the equipment (on-board and ground) and pointed out the main methods of solving it.

Not only were the set of questions relating to the growing role of the human factor reflected in V. A. Avaliani's paper titled "Role of the Efficiency of Man-Equipment Systems at the Stage of the Hastening of Scientific and Technical Progress," but a number of specific features of the human element (including of management) associated with the changing of industrial enterprises to self-support and self-financing were also touched upon.

B. Ya. Sovetov's paper titled "Problems of the Training of Specialists in the Field of Informatics" was devoted to a description of new information technology, its most important tasks and problems in need of a solution. The problem was discussed of the training of higher-school specialists in the field of informatics along three lines differing in knowledge levels and work experience. Examples were given of training specialists in the field of informatics.

The feasibility of using cybnernetic models of a power-generating unit whose functional characteristics are known and figure as a model of the operator's knowledge concerning the system was substantiated in a paper by A. F. Dyakov and S. D. Garbar titled "Modeling of a Power System As a Means of Improving the Effectiveness of the Control of a Power-Generating Unit."

In a paper by G. V. Sukhodolskiy titled "Procedural Questions Relating to the Efficiency, Quality and Reliability of Man-Equipment Systems" a thorough analysis was made of the interrelationship of the role of man in a man-equipment system, the human character and humanization of labor, and the efficiency, quality and reliability of man-equipment systems, and the feasibility was shown of making special practical studies of existing man-equipment systems and of ones being modeled and developed.

Integrated research on improvement of the efficiency of the operator's work in systems entailing heightened responsibility was summarized in a paper by D. K. Fedotov titled "Development of Highly Reliable Man-Machine Systems for Nuclear Power Plants." A number of recommendations relating to improvement of the operator's working conditions (reducing fatigue, monotony, etc.) were described, as well as industrial engineering designs that make it possible to reduce probable errors in the operator's work.

The "Business Meeting of Users and Developers" evoked particular interest among the symposium's participants. A series of developed software and methodological materials ready for transfer to and/or introduction in industry was suggested to representatives of industry at this meeting. Software developments called "Interactive Optimization System" (Novosibirsk), "PROSTAK System for Structural Analysis and Quantitative Evaluation of Functional Networks" (Leningrad), a number of ergonomic databases (Leningrad, Kharkov), the "Psychological Test Automation System" (Kharkov), a number of software support systems (Vilnius) and others were implemented on an SM [Series of Small Computers] computer. Some program systems oriented toward the automated solution of problems of the evaluation and optimization of control consoles (Minsk) were implemented on a YeS [Unified Series] computer. A number of software developments by Vinnitsa scientists oriented toward the automation of research on displays and of the optimal designing of algorithmic processes, toward the finding of errors in work, etc., were oriented toward DVK, Elektronika-60 and Yamaha computers. A number of technical-standards and methodological materials were presented in addition. More than 30 requisitions were issued during the business meeting for the acquisition of software and database management and support facilities, as well as for the transfer and adaptation of a number of techniques.

G. M. Kolesnikov delivered the basic-research paper "Problems and Their Resolution" in the first section. In this paper an attempt was made to formalize the description of a problem by superposing a transform of the situation at hand and the goal—a transform of the expected situation resulting from a special method of achieving the goal and from modification of the content of the starting situation.

A. P. Rotshteyn's basic research paper "Development of the Theoretical Principles of the Generalized Structural Method" was devoted to a discussion of formal methods of describing standard functional units (TFEs) and standard functional structures (TFSs), representing adequate descriptions of individual elements of action algorithms.

Of the exhibition stand reports the greatest interest was evoked by the following:

"Development of a Thesaurus—Formalization of Knowledge Concerning Flexible Manufacturing Systems as Man-Equipment Systems" by N. A. Bogoslovskaya and N. G. Sorokina, where an analysis was made of the principal difficulties of existing descriptions of flexible manufacturing systems associated with the fuzziness of concepts and the imprecision (ambiguity or synonymity) of terms, and the main ways of surmounting these difficulties were pointed out.

"Development of a Model of a Formalized Description of a Standard Functional Unit" by I. V. Kovalenko, in which the type of operation, the quantitative characteristics of individual components and of the system as a whole and the influence of the environment are taken into account.

"Interactive System for Analysis and Synthesis of Functional Networks" by A. P. Rotshteyn and A. G. Usach, where the SOKRAT [SOCRATES] system, implemented on a personal computer and making it possible to solve a number of man-equipment system optimization problems, is described.

"Study and Evaluation of Functioning of Monoergatic Systems Under Conditions of Limited Time Resources" by N. A. Mamedov. In this paper a method was suggested for formalizing the evaluation of a situation according to the extent of provision with time resources, based on comparing the time available to the operator with the time needed to solve the problem stated.

In the second section A. N. Adamenko presented a basic research paper titled "Functional Semantic Networks—a Universal Formalism for the Analysis, Design and Evaluation of Man-Equipment Systems." He gave grounds for the applicability of this formal device for describing and evaluating a wide range of real man-equipment systems and pointed out the feasibility of using them as a basis in the development of software systems making it possible for the unskilled user to model processes of the functioning of an entire system and to solve problems in evaluating and synthesizing its structures.

A basic research paper by Ya. Ye. Lvovich and Yu. I. Usov titled "Selection of Components of Expert Systems for Technological Purposes According to Efficiency Indicators" was devoted to a non-formal analysis of the subject area of the development of products and the designing of a process for manufacturing them.

The following exhibition stand reports evoked particular interest:

"Automation of the Analysis of the Consistency of the Functional Algorithmic Structure of a Man-Equipment System (Using an ASU GPS [FMS Automated Control System] as an Example)" by A. N. Adamenko and V. A.

Burdelev, in which a demonstration was given of a method of representing in the form of a set of knowledge bases a subtask and functional algorithmic structure and their relationships.

"Methods of Forming Knowledge Bases for Expert Systems by Evaluation of the 'Human Factor'" by T. A. Gavrilova. In this report a description was given of a number of methodological principles for the formation of knowledge bases according to the experience of the development of the first pyschodiagnostic expert system, AVTANTEST (Automatic Analysis of Tests).

"Structure of Knowledge Base for Optimal Man-Machine Expert System" by S. A. Zatsepina, Ya. Ye. Lvovich and V. N. Frolov. This report was devoted to methods of taking various requirements into account in the formation of the structure of a knowledge base: making possible the immediate retrieval of knowledge, the ability to check and logically analyze information, the independence of the knowledge base's organization on the problems to be solved, and the ability to add to and update knowledge. The structure of such bases for expert systems should make it possible to automate the solution of a number of practical ergonomic support problems that do not lend themselves to formalization.

"Results of Experimental Testing of Interactive System for Generation of Management Decisions for Large-Scale Controlled Systems" by V. B. Kiziriy, about an experiment in designing an interactive system for supporting the management of planning in Minavtotrans [Ministry of Motor Vehicle Transportation].

"Method of Intelligent Support of Reliability of Equipment" by M. G. Mirimskiy, in which the subject was the problem of the distribution of functions (realization of the advantages of man and equipment) in the development of especially complex equipment, and a method of solving it by the further improvement of one well known model of a pilot and by implementation in a computer-adviser system operating in parallel with the human operator in the modes of assessment of the situation, prompting and control.

The specific features of real ASUs [automated control systems] were pointed out in the third section in a basic-research paper by A. T. Asherov and G. A. Zakharov titled "Experience in Evaluation of Efficiency, Quality and Reliability of Real ASUs as Man-Machine Systems," and a set of problems was revealed, relating to the evaluation of the efficiency of complex man-machine systems for various purposes, that are to be solved as priorities in the development of new systems.

Of the exhibition stand reports the following attracted particular attention:

"Evaluation of Effectiveness of Man-Machine System Based on Analysis of Operator's (Air Traffic Controller's) Actions" by V. M. Basov, A. S. Gozulov and A. I. Fokeyev, in which a summary was given of integrated studies of the actions of an air traffic controller that made it possible to reveal the interrelationship of speed of response and his work's freedom from error. It was suggested that the approach discussed be used for an objective quantitative estimate of the effectiveness indicators of traffic control man-equipment systems.

"Models of the Quality of the Functioning of Ergatic Systems for Controlling Traffic of Moving Marine Entities" by O. V. Belyy and T. V. Mikhaylova, which suggested a method of evaluating the quality of such man-equipment systems based on the evaluation of the fulfillment of requirements formalized in the form of a fuzzy membership function. It was demonstrated that such an approach makes it possible to isolate the most important control parameters, organize database support according to these parameters, and predict accident situations in the system.

"Experience in Conducting Ergonomic Expert Examination of ASU Workstations" by T. N. Borshcheva and Ye. V. Vorobyeva, devoted to a description of the conduction of and of some results of an ergonomic expert examination of the functional hardware system of the computer center of a machine building enterprise.

"Ergo-Fields of Complex Systems. Application for Description and Evaluation of Ergonomic Systems" by Yu. N. Glazkov and K. V. Lyudvichek, devoted to a study of problems of analysis and classification, the development of new ergonomic parameters and characteristics, and the synthesis of the structures of ergatic systems. A system classifying ergo-fields according to their physical essence was presented. It was demonstrated that, depending on the specification of the ergonomic parameter, an ergo-field can be scalar, vector or tensor, and this approach can be used in describing and evaluating man-equipment systems.

"Method of Evaluating the Quality of Group-Action Algorithms" by V. I. Yeremeyev and A. M. Kuchukov, in which it was suggested that parallel TFSs [standard functional structures] be used for modeling action algorithms. The principal computing difficulties in the determination of quality indicators for group algorithms and methods of surmounting these difficulties were described in this report.

"Recognition of Motion and Machine Vision" by L. Ya. Zobnina, A. V. Redman and T. V. Tarasova was devoted to an analysis of methods of automating the ensurance of the safety of air travel (prediction of collisions). A new approach was suggested to describing the recognition of several objects that must take into account the frame of reference and that makes it possible to automate the solution of problems relating to the recognition of relationships characterizing a conflict situation.

"Formation of Library of Models of FMS Functioning Processes for FMS Qualimetric System" by V. P. Ivanov, A. N. Adamenko, Ye. A. Lavrov and S. G. Isayenko, in which an approach was described to the development of a system designed for estimating the quality indicators and optimizing the functioning processes of flexible manufacturing systems. The feasibility of using models of standard processes as part of the database was demonstrated. Models were obtained of the functioning processes of a number of modules.

A report by G. A. Kryzhanovskiy and G. V. Kovalenko titled "Procedure for Determining Level of Preparation of Aircraft Pilots" was devoted to a description of an approach to the development of a mathematical model of the process of the loss of skills and the process of recovering them. A method was suggested for determining the level of an operator's preparedness (key skills), as well as a technique for restoring it.

A report by Yu. N. Khalayev titled "Taking Account of Operator's Short-Duration Memory Capacity in Detection Modules" was devoted to a description of a model of the finding and recognition of a target by the operator of a marine radar. In this model, in addition to traditional principles of the synthesis of a model, the principle of the integration of parameters is employed—of technical (signal-to-noise ratio, probability of false alarm, etc.) and psychophysiological (short-duration memory capacity and threshold characteristics of detection) parameters—and the model makes it possible to obtain the required estimates by means of uncomplicated calculations. The algorithm of a calculation program implemented on a YeS-1035 computer is presented.

In the fourth section Ye. B. Tsoy presented a basic-research paper on the topic "Problems of Optimization, Design and Analysis of Experiment in Tasks of Designing and Studying Man-Equipment Systems," in which the feasibility of using optimization methods implemented in the form of software packages for solving man-equipment system optimization problems was substantiated. The presenter of the paper made an analysis of available optimization methods and algorithms and their software implementation and demonstrated the importance of automating the solution of man-equipment system optimization and design problems based on the creation of a "base" and/or a "BANK" of models (including regression models).

A basic-research paper by G. G. Manshin titled "Methodological Aspects of Development of Highly Reliable Man-Machine Technologies" was devoted to a description of a methodology developed at ITK AN BSSR [Institute of Engineering Cybernetics, Belorussian SSR Academy of Sciences] for analyzing the quality and reliability of man-machine technologies at the early design stages. The methodology uses the mechanisms of teaching, anticipation, self-testing, action readiness, etc., and takes into account various kinds of redundancy of both hardware and ergatic components, as well as a number of preventive inspection measures.

One of the main trends of present-day radio engineering—the broad introduction of automated remote-controlled manipulation systems for the performance of complex operations under conditions representing a hazard to man—was touched upon in a basic-research paper titled "Ergonomic Designing of Remote-Controlled Manipulation Systems" by Ye. P. Popov and A. S. Yushchenko. A procedure for research and the processing of experimental data was suggested that has software and is successive, with the successive refinement of the mathematical model in the detail design process as well as in tests of simulated models.

The following exhibition stand reports evoked particular interest:

"Interactive System for Optimization of Human Engineering Systems Utilizing Functional Networks" by M. G. Grif and Ye. B. Tsoy, in which a description was given of the DIFUS software package that makes it possible to solve a set of discrete combinatorial optimization problems (scalar, vector, parametric and stochastic) interactively.

A paper titled "Recognition of Standard Functional Units in Database-Program Module for Designing of Functioning Algorithms" by L. S. Demchenko was devoted to a method of describing an abstract generalized TFE [standard functional unit] with every possible output, input and logic, making it possible to identify a TFE unambiguously according to the number of inputs and outputs and according to their logical interrelationship. A conversation with the user is organized in case any TFE is not recognized.

A report by P. I. Paderno titled "Determination of Tentative Size of a Team" in which a study was made of a mathematical model of the functioning of a human engineering system as a queuing system. The two-step method suggested for determining the size of homogeneous teams can be used both for a tentative estimate at the early design stages and at later stages for precisely determining the size of units solving problems of the same type.

In a report titled "Interactive Procedures for Computer-Aided Design Systems" by O. I. Tereshchenkov an interesting approach was suggested to the designing and implementation of a conversation in a computer-aided design system that makes it possible to reduce the number of operator's errors.

A report by I. E. Tom titled "Problem of Optimization of Spatial Configuration of Operator's Workstation" in which an integrated approach was discussed to the automation of the design of the spatial configuration of a workstation taking indicators of the quality of actions into account, a formulation of the optimization problem based on fuzzy set theory was presented, and some intermediate results were described.

A report titled "Theoretical and Practical Fundamentals of Evaluation and Optimization of ASU TPs [Plant Technical Management Automation Systems] for Heat-and-Power Equipment of Electric Power Plants" by D. K. Fedotov, in which a summary was given of a set of studies relating to the estimation of quality and efficiency indicators in the variate designing of ASU TPs, and a database, developed for the automation of design calculations, for the evaluation of the actions of the personnel of various plants was talked about.

A report titled "Optimization of Training of Operators of Man-Equipment Systems With Probability Constraints" by P. P. Chabanenko, in which a teaching model was described making it possible to assess the dynamics of the faultlessness of operators according to the characteristics of the actions to be mastered, and a method of solving the problem of the optimization of the training of operators was also described.

The following basic-research papers were presented in the fifth section:

"Computer-Aided Design of Hierarchical Man-Equipment Systems" by V. G. Yevgrafov, which revealed the basic directions of the development of such man-equipment systems and gave a classification of the individual problems, as well as the main principle of the integrated solution of these problems based on automated dynamically linked subsystems.

"Hardware System for Ergonomic Support of Models of Equipment" by V. M. Akhutin, A. S. Sidorov and G. A. Strugach, devoted to a description of a hardware-software system implementing the modeling of man-equipment systems and the measurement and processing of ergonomic characteristics. A problem classification system was presented and the most promising hardware systems were pointed out for solving each class of problems as a function of external conditions, goals, etc.

A number of exhibition stand reports evoked the particular interest of specialists.

A report by Yu. B. Bluvshteyn and B. M. Reshtuka titled "Evaluation of Efficiency of Marine Teaching Systems" was devoted to the relationships between the efficiency of a teaching system—defined as the duration of the training cycle prior to the attainment of a specific educational level—and the control system structure used.

A report by V. M. Voynenko, B. M. Gerasimov, Yu. V. Gulevskiy and G. P. Popov titled "Hardware System for Modeling and Optimizing an Operator's Actions" in which a description is given of a simulator for analyzing and synthesizing an operator's actions, taking into account the adaptation, extent of fatigue, level of training and functional state of the operator, etc. The simulator is being used for the designing of actions and facilities for supporting them in ergatic systems under development.

A report by L. S. Demchenko, G. A. Zakharov and Ye. V. Popov titled "Principles of Computer-Aided Design of Informational Models" in which a set of rules was suggested for the two-step designing of informational models that ensures the completeness of the representation of information concerning the subjects of design and control in the environment, and that makes it possible to automate the process of the generation of functioning algorithms and to construct according to them ergonomic informational models on control consoles.

A report by G. M. Kotler titled "Computer Study of Reliability of Ergatic Systems" in which a description was given of a specialized system for simulating an operator's actions relating to controlling a dynamic system. The system makes possible the description of both continuous and discontinuous control actions of an operator, as well as a broad range of descriptions of individual components of man-machine systems.

A report by S. G. Sonina, T. V. Tarasova and V. L. Shnyrin titled "Study of Effectiveness of Ergonomist's Use of Computer in Configuration of an Operator's Console", devoted to an analysis of the time spent by an ergonomist at various stages of his work, which showed that the greatest difficulties are associated with formalization of the operator's actions in optimization of the console configuration alternative and with formalization of the result of this configuration. The effectiveness of including a computer in the process of the ergonomic design of consoles was demonstrated.

In the sixth section A. V. Budikhin and V. A. Kokushkin presented the basic-research paper titled "Conceptual Design of Database Systems." This paper was devoted to a description of special database facilities and software making it possible to construct conceptual models of data.

The integrated development of various components of an ergonomic data bank was summarized in a basic research paper by A. I. Gubinskiy, P. I. Paderno and Ye. V. Piyevskaya titled "Development Problems and Prospects of an Ergonomic Data Bank." The enumeration of the databases and data files to be included in the bank, as well as its structure representing the interrelationship of individual data and pieces of knowledge, evoked lively discussion. The immediate and long-range prospects for the development of this bank and its use for purposes of the automation of ergonomic support in the development, design, study and testing of complex man-machine systems for various purposes were given clear grounds for in this paper.

Of the exhibition stand reports mention must be made of the following:

A report by A. M. Aflitunov and Ye. V. Piyevskaya titled "Conception of Structure of Distributed Data and Knowledge Bank for Machine Building Products" in which a description was given of the structure of local, centralized and interdepartmental networks, as well as of the functions to be performed by each network.

Reports by A. T. Asherov et al. titled "Modeling of Subject Area of Data Concerning Quality of Operator's Execution of Actions and Operations", "Database Interactive Access System" and "Quality of Operator's Execution of Standard Actions and Operations" in which the database was described in detail.

A report by V. M. Voynenko and Ye. A. Semenyuk titled "Modeling of Key Functions of Branch Bank of Ergonomic Specifications" devoted to a study of the features of the structure and functions of database management and support and to the solution of product design and quality control problems in instrument making.

A report by S. V. Volchkov and S. V. Rusanov titled "Automated Processing of Information on Safety of Manufacturing Man-Equipment Systems", concerning the design of a data bank containing information concerning the sociodemographic-caused component of disability.

A report by I. V. Kovalenko and L. S. Demchenko titled "Organization of Preparation of Initial Data on Reliability of Standard Functional Units (TFEs) by Using Information of Databases on Characteristics of Man and Equipment", in which a number of mathematical relationships were presented that relate the reliability characteristics of man-equipment system components (man, working tools, item worked on) to the individual indicators of the functioning of the man-equipment system as a whole.

A report by L. V. Pellints, S. Ye. Rodionov and A. M. Yashchin titled "One Implementation for Improvement of Reliability of Input Information in Man-Equipment System", devoted to a description of special software (software package) that inputs and checks data interactively and outputs diagnostic messages concerning the user's input errors (noncorrespondence to pattern, set of permissible values, etc.).

A report by Ye. A. Semenyuk titled "Some Aspects of the Socioeconomic Effectiveness of the Development and Use of a Bank of Ergonomic Specifications", devoted to a study of a set of questions relating to a comparative assessment of the profitability of various organization and technical solutions relating to the bank.

The growing relevance of the problem was stressed in a resolution adopted by the symposium's participants and the basic directions of the research being conducted were approved.[1]

It is noted that, in spite of the considerable scientific and technical and methodological support available, all the same the necessary attention is not being paid to questions relating to efficiency, quality and reliability, by properly taking the human factor into account, in the day-to-day solution of problems relating to the development and use of many man-machine systems. The symposium proposed a set of specific measures for improving the solution of the problem and noted the positive experience of the Interbranch Basic Research Committee on Ergonomics of the Lenoblsovet NTO [Leningrad Oblast Soviet Scientific and Technical Department] in propaganda and advisory work on the problem.

Footnotes

1. "Sbornik tezisov dokladov VIII Vsesoyuznogo simpoziuma 'Effektivnost, kachestvo i nadezhnost sistem "chelovek-tekhnika"'" [Collection of Theses of Papers of Eighth All-Union "Efficiency, Quality and Reliability of Man-Equipment Systems" Symposium], Parts I and II, VSNTO [All-Union Council of Scientific and Technical Societies], Tbilisi, 1987.

UDC 658.52.011.56.061.3

Problems in Automating Production Discussed at Voronezh Symposium

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 6, Jun 88 pp 77

[Article by A. Volchkevich, doctor of technical sciences and chairman of the All-Union Council of Scientific-Technical Societies' Committee on Automation]

[Text] The Fourth All-Union Scientific Technical Symposium on Problem Issues in Automating Production, which was organized by the All-Union Council of Scientific-Technical Societies, was held in Voronezh in October 1987. The symposium takes place on a regular basis once every 3 years. The preceding meetings were held in Riga, Krasnodar, and Minsk.

During this time, the symposium has acquired its own distinctive direction: a discussion of the most burning and pressing issues related to automating production at the technical policy level and analyzing its status and prospects. The conference was attended by scholars and engineers, technologists and designers, and representatives of the sectorial and higher education scientific communities and the foremost enterprises and associations that are directly involved in designing, operating, and researching automatic machines and systems of such machines.

Plenary reports were presented at the symposium, and discussions were conducted on specific problems, the most important of which were how to make flexible manufacturing systems efficient and how to avoid the losses and disappointments that accompanied the wide-scale introduction of industrial robots and automated enterprise management systems before them.

Not one of the numerous participants in the discussion would have failed to express his or her bitterness over the planning practice that has taken shape, i.e., the wide-scale creation and introduction of flexible manufacturing systems independently of any improvement in engineering decisions and the preparation of enterprises. There is an urgent need to develop the scientific bases for and concepts of technical policy when automating flexible manufacturing. It is, first and foremost, necessary to determine where the use of flexible manufacturing systems is rational while considering such factors as batch production, the range of products, the frequency of retooling, and the size of the lot being launched into production.

Is it realistic to demand a guarantee that flexible manufacturing systems will function reliably in an unmanned mode in the near future? Is the creation of flexible manufacturing systems primarily for machining and conditions of small-series and series production—with the accent on "local" flexible manufacturing systems consisting of two to six machine tools distributed in a set of enterprises—which has spontaneously been given priority, promising? The answers given to these and many other questions, all the diversity of approaches aside, were mainly negative.

The discussion about retoolable automated lines, which hardly anyone in our country is working on creating, aroused particular interest. Are they simply a modification of the equipment or are they one of the main directions in integrated automation of production in machine building, instrument making, and other sectors? Yes, they are. More than a few examples and confirmations of the high efficiency of domestic and foreign retoolable lines were presented at the symposium.

For the first time, a discussion was organized on the fields in which the use of rotary and rotary-conveyer lines should be given priority.

Today's success with and the popularity of rotary lines is explained not only by the use of progressive principles of concentrating operations and on the continuity of action in their designs but also on the degree to which their basic designs has been refined—something that has yet to occur in the case of flexible manufacturing systems. Clearly, the "ecologic niche" of rotary lines has not yet been filled. But how large is it? Will not rotary lines meet the same fate as automated enterprise management systems if they are installed where they are needed and where they are not? This may occur if those processes and products that should be given priority for machining on these lines—particularly under conditions of retoolability and group machining—are not carefully identified.

It was noted in practically all of the sections that success in the integrated automation of flexible manufacturing, no matter how progressive the models of rotors and computers that are built in, is impossible unless retoolable production equipment is created. The discussion on the problems entailed in improving the designs and organization of centralized production of equipment on the necessary scales showed the enormous amount of harm inflicted by a lack of coordination between departments and the absence of a unified technical policy in the sphere of equipment on the interbranch level.

The arguments and discussions did not end after the sessions. The organizing committee ended the session discussions in order to conduct a concluding plenary session. The symposium participants were unified in spirit in one respect: contemporary automation systems and equipment should solve social problems in coordination with the economy. Only then will they be really efficient.

The organizational committee set the next symposium to be held in 1990 in Tula.

Restructuring Discussed at All-Union Seminar on Gear Trains

18610042c Moscow VESTNIK MASHINOSTROYENIYA in Russian No 6, Jun 88 p 78

[Article by N. A. Gormanyuk, scholarly secretary of the Gear Train and Reducing Gear Production Section of the Central Administration of the All-Union Scientific-Technical Society of Machine Builders]

[Text] Within the framework of the All-Union Scientific-Technical Society of Machine Builders, 22 gear train and reducing gear production sections are currently operational in the republic and oblast administrations. The Central Administration, which periodically provides seminars in which the directors of the regional sections participate, coordinates the operations of all of the sections.

The All-Union Seminar of the Directors of the Gear Train and Reducing Gear Production Sections of the Republic and Oblast Administrations was held in Riga from 17 to 18 February 1988. It included the following:

1. An exchange of operating experience among the different sections;

2. Compilation of a unified plan of operations for all of the sections and the elimination of duplicate measures; and

3. A discussion of new forms of operation in connection with the formation of the USSR Council of Scientific and Engineering Societies and the restructuring of their activities under conditions of full cost-accounting.

Reports were presented by the chairmen of the 18 regional sections. They spoke of the main directions of their activity for the accounting period and about the course of the fulfillment of their plans for 1988. According to these speeches, the main types of activities conducted in the sections are as follows: scientific-technical seminars and conferences, technical assistance to enterprises in solving complex scientific-technical problems, and coordination of the scientific-technical activity of specialists in their own region.

During the course of the discussion there was an evaluation of the activity of the different sections. It was noted that in some cases there is a formal attitude toward the work being conducted and an attempt to take credit for the success of the labor collectives in introducing scientific-technical progress. Most of the sections, however, are capable social headquarters in the management of the activity of specialists from their area who are working in the field of gear trains.

It was decided at the seminar that an all-union scientific production conference entitled "Experience of the Machine Building Sectors—Into Tractor Building" and a republicwide scientific-technical conference on Novikov gearings would be conducted in 1989.

The seminar program also included 11 reports on pressing problems in the design, manufacture, and operation of gearings:

"Some Problems in Gearing Durability" (V. N. Kudryavtsev, doctor of technical sciences);

"Calculating Reliability of Reducing Gears" (G. A. Snesarev, doctor of technical sciences);

"State of the Art, Development, and Some Practical Results of the Theory of Gearings in Generalizing Parameters" (E. B. Vulgakov, doctor of technical sciences);

"Problems in Norming and Testing Gearing Precision" (I. P. Nezhurin, candidate of technical sciences);

"Prospects for Using Blades to Cut Hardened Teeth" (G. G. Ovumyan and O. I. Antonov, candidates of technical sciences);

"Tribological Methods of Increasing the Service Life of Gearings and Other Kinematic Pairs" (B. B. Pavlik, candidate of technical sciences);

"Comparative Characteristics of Calculating the Durability of Cylindrical Evolvent Gearings According to GOST 21354-75 and GOST 21354-87" (D. E. Goller, candidate of technical sciences);

"Normative-Technical Documents in the Field of Calculations of Gearings" (N. M. Shlomov, candidate of technical sciences);

"Thermochemically Treated Materials for Gearings" (I. P. Banas, candidate of technical sciences);

"State of the Art of Designs for Novikov Gearings" (A. S. Yakovlev, candidate of technical sciences); and

"Features of the Cutting of Round-Toothed Conical Gears" (K. K. Paulinsh, candidate of technical sciences).

At the seminar's conclusion, Professor V. N. Kudryavtsev presented his ideas about the role of the arts in the education of specialists in nonhumanities professions.

Problem of Modeling in Machine Building Discussed

18610036b Moscow MASHINOVEDENIYE in Russian No 43, Jul-Aug 88 pp 121-122

[Article by S. G. Frolov]

[Text] A conference entitled "Modeling in Machine Building" was held in November 1987 at the Science of Machines Institute [IMASh] imeni A. A. Blagonravov of the USSR Academy of Sciences. The conference participants included I. S. Silayev, deputy chairman of the USSR Council of Ministers and chairman of the USSR Council of Ministers Office of Machine Building, domestic workers from the USSR Council of Ministers Office of Machine Building, Academician K. V. Frolov, vice-president of the USSR Academy of Sciences, members of the USSR Academy of Sciences, and leading scholars from the IMASh of the USSR Academy of Sciences.

In his report, K. V. Frolov assessed the state of the art and prospects for the development of basic and applied research in machine building based on modeling and physical modeling methods as well as the degree to which experimental stands and equipment have been provided for such research. He mentioned the importance and large volume of developments that the institute's laboratories are making with regard to modeling new production processes and modeling building materials and operating processes in machines that will increase their reliability and life, durability, wear resistance, vibration resistance, and ecological and ergonomic characteristics. The preparation of scientific-methodological and reference-design directive materials related to modeling (especially physical modeling), the creation, finishing, and testing of mechanisms and machines in the IMASh and other institutes, and the subsequent transfer of these materials to industrial organizations is not, however, meeting the needs of the machine building sectors. The report also mentioned the need to develop modeling methods in the field of machine dynamics, multicriterial optimization of working processes, the reliability and durability of machines and designs, mechanotronics, metrology, and ergonomics. More attention must be paid to modeling when forecasts of development in machine building are compiled and when estimates of the parks and operating lives of machines needed are made. In this context, there must be a new approach to training technical, engineering, and scientific personnel and giving them the high qualifications required to meet the current demands of scientific and production technology. Special attention must be paid to their practical training in and mastery of mathematical and physical modeling methods as well as to the testing of machines at production enterprises and in scientific institutions, including academic institutes.

In conclusion, K. V. Frolov explained why a "scientific center for modeling in machine building" with a modern computer center and with experimental and pilot production needs to be created at the IMASh. Through a network of connections with branch scientific research institutes and scientific production organizations, the center for modeling will provide efficient methodological assistance to the country's industry.

Doctor of Technical Sciences A. V. Sinev demonstrated modeling of the interaction in a man-machine system on vibration tables. He noted the particular value of these operations in ensuring the safety of personnel working on machines with a high level of vibrations—agricultural machinery (combines, tractors, sowers, etc.), road and mining machinery, power-generating units, etc.

Basic research using modeling methods was the foundation of ergonomic requirements for machines, particularly the effect of vibration on the activity of the human organism. The priority of developing the theory of and modeling man-machine systems under vibration conditions and of establishing norming and standardization for these systems was noted.

R. F. Ganiyev, corresponding member of the USSR Academy of Sciences, presented developments related to modeling processes of wave technology in machine building. The mechanical and physical foundations of wave technology processes have recently been developed on the basis of models of nonlinear vibrations of solid bodies and multiphase systems containing liquid and gaseous components. The development of scientific research in this direction is being impeded by inadequate experimental plants. The use of wave technology has made it possible to achieve significant (by an order of magnitude or more) improvements in productivity and reduce the amount of power required by a number of production processes in oil recovery and petrochemistry, microbiology, power engineering, etc. To introduce wave technology at machine building enterprises on a wide scale, it is advisable to create a "scientific-engineering center for wave technology" complete with pilot production.

Professor V. G. Lyutsau discussed the principal results of works dealing with modeling and optimizing structures made of composites. The creation and use of composites in modern machines and structures intended for different purposes is very urgent. This makes it possible to improve a machine's characteristics from the standpoint of durability, resistance to effects of the environment, weight, power and labor costs, and consumption of metal ten times over.

A number of specific design decisions for agricultural machinery, motor vehicles, transport equipment, machine tools, and robotics systems have been developed and proposed at the IMASh of the USSR Academy of Sciences. The fact that planning and experimental-design developments in the machine building sectors lag significantly behind basic progress because of a lack of special equipment for processing composites into products and a lack of the respective specialists in design offices and scientific production organizations was noted. Increasing the durability of ag. .cultural machinery by using new composites, ,articularly these machines' soil-cutting tools, fertilizer and pesticide tanks, and livestock breeding systen s, requires the creation of new models of machine building designs.

The report presented by N. A. Makhutov, corresponding member of the USSR Academy of Sciences, was devoted to modeling nuclear and thermal power generation systems to estimate their reliability and durability. Complex physical models of power reactors as well as unique equipment created by specialists at the IMASh have made it possible to develop practical recommendations for forecasting the life of the most critical systems of power-generating units. The advisability of sending the methods developed to branch scientific research institutes and the need to create measurement complexes to modernize and test full-scale nuclear and thermal power facilities were noted.

Professor A. V. Chichinadze's communication was devoted to modeling processes of the wear of friction nodes and testing for them. He noted that the set of scientific research projects that have been begun in a number of machine building sectors is extensive. He noted that insufficient attention has been paid to increasing the wear resistance of the nodes of agricultural machines, particularly that due to abrasive wear. He spoke of the need to undertake a joint project with the All-Union Agricultural Machinery Construction Scientific Research Institute [VISKhOM] on the physical modeling of the processes of designs for agricultural machines that cut and come into contact with the soil as well as the need to expand full-scale tests of reinforced components for these machines.

In his report, Doctor of Technical Sciences V. K. Grinkevich spoke of the results of modeling vibroacoustic processes in automobile manufacturing. He demonstrated a number of modeling complexes for actual items of automotive technology. A number of important results have been obtained in vibroacoustics research. Practical recommendations for increasing machine quality have been developed, methodological materials for specialists at design offices and enterprises have been compiled, and highly sensitive and particularly precise vibroacoustic measurement systems with characteristics surpassing those of the best foreign prototypes have been created. It was also noted that developments and recommendations for improving the vibroacoustic characteristics of automotive and other technology are being introduced very slowly.

In his summary of the conference proceedings, I. S. Silayev paused on the main tasks facing contemporary domestic machine building and made a number of proposals for developing the work being done at the IMASh. The main task facing machine building is that of reaching the world level from the standpoint of the quality, reliability, and durability of machines. In the agenda for using modeling in machine building special attention must be given to the development of methods for the physical modeling of real objects of the technology being created, methods for processing and analyzing the modeling results, and unified methods of researching and estimating machines' lives. It would be advisable to create a modeling center and a council on modeling in machine building to accomplish and coordinate these tasks.

Practical manuals on methods of ensuring the reliability of technology being created in the design stage, on tests for complex systems and the processing of measurement results, on optimal design methods, and on using modeling to refine designs must be developed as quickly as possible. Recommendations on ways of making the maximum use of composites and other substitutes to reduce the amount of metal used in machines must also be developed. Projects dealing with using the scientific progress that has been made by the IMASh in accomplishing the practical tasks facing machine building, including hardening soil-working tools and using wave technology methods, should be stimulated. The practical assistance provided to enterprises relative to methods of testing, developing, and improving the Don-1500 combine and agricultural machinery for transporting and dispensing aggressive fluids so that their service life and operating reliability can be significantly increased should be expanded.

UDC 658.18:061.3

Soviet Achievements in Field of Resource Conservation Exhibited

18610074b Moscow VESTNIK MASHINOSTROYENIYA in Russian No 9, Sep 88 pp 70-73

[Article by I. A. Tsygankova, engineer, under the "Acceleration—A Matter for the Entire Nation" rubric: "Resource Conservation, 88"]

[Text] The following are very important directions in resource conservation: reducing the amount of materials required for production, improving the norming of the consumption of physical resources, replacing materials that are in short supply with raw materials and materials that are not in such short supply, introducing above-norm and unused material assets and secondary physical resources into economic circulation, and developing a system of services to prepare products for production consumption.

The 27th CPSU congress stipulated the task of satisfying 65 to 70 percent of the increasing need for physical resources within the current five-year-plan by economizing on them in all spheres of material production and consumption.

Transferring the country's economy to an intensive path of development will be impossible without the accelerated introduction of scientific-technical progress into each sector's production and disseminating (on a wide scale) the experience that the sectors and enterprises have accrued in matters of design, technology, the organization of production, and the use of technology.

All of this has been reflected in the work of the higher educational institutions and those that are cooperating in using secondary raw materials and production wastes and in the works to economize on physical resources, implement resource-conserving directions, and create new technology and processes and introduce them into the production processes used at fuel and power generation, metallurgical, machine building, construction, chemical and forestry, and transport complexes represented at the interbranch exhibition entitled "Rational Use of Physical Resources in the National Economy"—"Resource Conservation, 88."

The exhibition was organized by the USSR Exhibition of National Economic Achievements [VDNKh SSSR] and USSR Committee for Material and Technical Supply [Gossnab]. Forty ministries and departments, a number of union republics, the Moscow gorispolkom, and its organizations took part in the exhibition. The ministries and departments presented a program called "Economy" that was linked with solutions to the following problems stipulated by the 27th CPSU congress: reduce the amount of physical resources consumed by social production by 4.5 percent, reduce the power intensity of the national income by 8.5 percent, and reduce its metal intensity by 15 percent. The state program entitled "Metal Intensity," which was represented at the exhibition, encompasses the activity of the metallurgical, machine building, and construction complexes and stipulates cutting the metal intensity of the national income in half by the year 2000.

The machine building ministries' booths showed ways of making rational use of progressive metal production and presented the economic and technical characteristics of new machines and mechanisms and progressive production systems.

The All-Union Hydraulic Drive Scientific Research Institute, and All-Union Diesel Engine Scientific Research Institute are proposing manufacturing type GTs cylinder sleeves from precision blanks based on precision cold-drawn pipes having the dimensions 114 x 7.5 mm with no allowance for the outer diameter and with a 1-mm allowance for the inner diameter. The limit deviation for the inner diameter is plus 0.5 mm, that for the wall thickness is plus or minus 7.5 percent, and that for the mass of 1 running meter of pipe is 19 kg.

Using a precision round billet made it possible to reduce the labor intensity of machining by 50 percent (compared with hot-rolled pipe) and increase the metal utilization factor to 0.86 (compared with 0.6). The precision round billet surpasses the domestic and foreign prototypes from the standpoint of precision of manufacture and strength characteristics.

The Armenian Machine Building Scientific Research and Technological Design Institute [ArmNIImash] developed an automated line for hot-stamping components from spherical billets and launched it into production.

Technical and Economic Indicators of the Line

Yearly program, millions of units	1.5
Productivity, components/h	600-900
Maximum sphere diameter, mm	50
Metal utilization factor	0.7
Annual savings of metal, tons	450
Yearly economic impact, millions of rubles	1.5

Working jointly with the All-Union Tool Scientific Research Institute [VNIIinstrument] and Vilniyus Drill Plant, the Forging and Pressing Machine Building Experimental Scientific Research Institute [ENIKmash] created an easy-to-retool complex for the hot extrusion of the profile of the of blanks for the bodies of spiral drills between 14 and 35 mm in diameter (instead of manufacturing large spiral drills by milling and rolling with the subsequent spiraling and extrusion). The advantages of hot extrusion of drill blanks in the complex are as follows: a 40 percent reduction in the consumption of high-speed steel as compared with milling, a 3.8-fold reduction in labor intensity, and an improvement in product quality. Twenty-five type sizes of cylindrical blanks can be processed on the complex and turned into 44 type sizes of drills. The process of producing drill blanks on the complex is as follows. Blanks are loaded into a storage unit oriented according to cooling openings. They are moved into the storage unit's heating zone. Next, they are automatically fed from the storage unit to a movable three-section induction heater. From the induction they are transported to a saline bath, after which they are loaded into the press' tool block.

Key Data on the Complex

Press' rated force, kN	1,250
Load-carrying capacity of the loading/unloading device, kg	12
Dimensions of the drill blanks extruded, mm:	
Diameter	14-35
Length	282-478
Productivity with no allowance for the utilization factor for drill blanks with the following diameters, units/h:	
14 mm	80
35 mm	45
Total installed capacity (allowing for electric heating), kW	143
No. service personnel	2

The yearly economic impact from introducing one complex is 600,000 rubles.

The world's first working ferrohydrostatic separator, the FGS-70, for a new resource-conserving process has been created in the USSR. It allows the processing of complex nonferrous metal wastes by density, which makes it possible to reduce aluminum losses from 18 to 23 percent, copper losses from 16 to 84 percent, and lead losses from 25 to 50 percent and return them to the production process in pure form. The FGS-70 separator is intended for separating, by density in a ferromagnetic fluid, crushed cable scrap, scrap from household electronic equipment, and other nonmagnetic materials into products ensuring the output of conditioned metals and alloys. Thus, a mixture of scrap and copper, zinc, lead, aluminum, and tin wastes may be separated into individual metals, and a mixture of scrap and aluminum alloy wastes may be separated into alloys according to the systems Al-Mg, Al-Cu-Si, and Al-Zn. The mutual contamination during the separation of the scrap mixture and the copper, lead, and aluminum wastes is minimal. Thus, the copper and aluminum fractions do not contain other metals, and the lead fraction contains no more than 2 percent aluminum and copper.

The separator's operating principle is based on the use of the buoyancy arising in the ferromagnetic fluid when it interacts with an inhomogeneous external magnetic field. The annual economic impact from using one separator is 268,500 rubles. The FGS-70 separator does not have any foreign or domestic analogues. It has been patented in the FRG, France, CSSR, GDR, Poland, and Bulgaria. It was developed by the State Coal Concentration Machine Building Institute [Gipromashugleobogasheniye].

This same institute developed the SE-3 electromagnetic separator, which is intended for extracting iron- and manganese-containing bronzes from mixed bronze chips and scraps, iron- and manganese-containing brasses from a mixture of brass chips and scrap, and tungsten- and cobalt-containing nonferrous metal wastes.

The separator's operating principle is based on the difference between the magnetic properties of different types of alloys. The separator is used at the enterprises of the all-union production association All-Union Secondary Nonferrous Metals Institute [Soyuzvtortsvetmet]. The integrated processing of nonferrous metal chips and wastes has saved the national economy 12,600 tons of zinc, 4,500 tons of copper, 4,000 tons of tin, 3,600 tons of lead, more than 9,000 tons of other nonferrous metals, 6.57 million kilowatt hours of electric power, and 38,000 tons of equivalent fuel. Using the separator has completely eliminated losses of expensive alloying components. The annual economic impact from using one separator is 570,000 rubles. The SE-3 separator does not have any foreign or domestic analogues, and it has been awarded author certificates No 722578 and 97822.

The portable plasma machine Mikron-2-02 is intended for air-plasma cutting sheets from ferrous and nonferrous metals in the blanking sections of machine building and metal working enterprises. The new design features improved thermal insulation and an improved drive, the machine's stability has been improved, and the cable and hose lengths have been doubled thanks to an increase in the current density in the nozzle channel. Cutting productivity has been increased 1.5-fold thanks to an increase in current density in the nozzle channel. Expenditures of electric power per 1 meter of cutting have been reduced 1.25-fold to 1.4-fold. It was developed by the All-Union Autogenous Machine Building Scientific and Design Research Institute (Moscow) and the production association Kirovokanavtogenmash.

The Pereraspredeleniye [redistribution] management automation system is an industrial management system performing intervening functions related to redistributing raw material, materials, products used to complete sets, other physical resources, and equipment between industrial enterprises located in one economic region. The following are the principal services provided by the Pereraspredeleniye ASU:

Periodically organizing the redistribution of unused resources and equipment between enterprises using the automated system and searching for and formulating versions of exchanging resources between user enterprises;

Providing information and reference services for users (periodic publication of bulletins on unused resources and bulletins of exchange proposals as well as timely issuance of responses to user queries);

Making an allowance for factors in resource distribution.

The automated information and measurement system Energoresursy [Power Resources] has been included as a component of the production organization and management automation system of the production association Nizhenekamskneftekhim [Nizhnekamsk Petrochemical Institute]. It is intended for use in on-line accounting regarding the use of electric power and thermal power resources at the production association as well as for on-line monitoring of the status of electric equipment at the production association's main substations.

The automated information and measurement system's hardware is based on the following domestic technology: an SM-2M central computer, an M-6000 buffer computer, TM-31 telemechanics devices, and IISE-2 complexes. Its software is implemented in the environment of the ASPO disk operating system. The Energoresursy automated information and measurement system organizes the following information in its data base:

information about the status of coolants (water, steam, gases, steam condensate) is collected from pressure, flow rate, and temperature pickups and is processed every 2 minutes;

information about the status of electric power (consumption, capacity, demand) is collected and processed at half-hour time intervals (the information comes from IISE-2 microprocessor systems);

information about the status of electrical equipment (normal versus abnormal status) is collected from relay contacts to a KP TM 301.

Production processes for the precision stamping of steam and gas turbine blades have been developed by the All-Union Power Engineering Industry Planning and Technological Institute [VPTIenergomash] and introduced at the Leningrad Turbine Blade Plant Production Association. The progressive technology includes preparing blanks by stamping on a radial forging machine with numeric control and on horizontal machines, stamping combined with trimming the flash and calibration combined with hardening, and heating for deformation in induction units and low-oxidation furnaces with a protective atmosphere. The manufacture of 19 type sizes of blades made of different materials and with lengths up to 600 mm has been launched on the basis of the technology of precision shaping. The rated allowance for machining the bodies of blanks meets the requirements that have been set for finished blades. The deviation from the theoretical profile is 0.2 to 0.3, and that with respect to the body thickness is 0.4 to 0.6 mm. The economic impact as calculated for the planned yearly program of manufacturing the range of blades that have already been launched into production amounts to 330,000 rubles, 60 tons of metal saved, and 33,200 fewer norm hours to manufacture the blades.

The scientific production association Geliymash has developed and introduced a waste-free production process for stamping aluminum components by the cold extrusion method. The components are intended for adapter components manufactured by cold welding and operating under conditions of periodic heat exchange with a high temperature gradient with different intensities and types of force effects. The process completely eliminates the subsequent machining of components on lathes. It takes 30 to 60 seconds to stamp one component. The labor intensity of manufacturing aluminum components has been reduced by 40 percent. Using standard pipes as blanks for stamping aluminum components intended for adapters of various materials with an inner dimension of 10 to 120 mm has permitted a three- to sixfold reduction in metal consumption.

New methods of joining various materials have also been developed and introduced into the production process at the production association Geliymash. These include cold welding of various materials and the pressed adhesive joining of glass-reinforced plastic and metals. The structural components produced in this manner may operate under high temperatures and with different intensities of force effects. The cold welding method makes it possible to weld aluminum alloys with titanium alloys and stainless steels, and the pressed adhesive method makes it possible to connect glass-reinforced plastic with aluminum and its alloys as well as with stainless steels and titanium alloys. The advantages of the specified joining methods are as follows: the process is highly productive and simple, it affords the possibility of connecting different materials, it produces joints that are highly reliable at temperatures from 4.2 K to that temperature that is determined depending on the materials joined together, it permits the use of any automated and universal equipment for machining and die-forging the blanks, and no further machining of the joints is required.

The production association Kislorodmash imeni the 60th Anniversary of the Great October Socialist Revolution has proposed low-pressure cold welding to join 10-mm-diameter pipes made primarily from 12Cr18Ni10Ti steel. The method expands the technological capabilities of obtaining nondetachable butt joints of pipes made of heterogeneous and homogeneous metals to manufacture adapters and long lengths of small-diameter, standard-length pipe, and it ensures the production of strong, leak-tight welded joints with a minimum thermal effect zone and a good commercial appearance. Replacing brazing with PRye-40 silver solder saves 0.4 to 1.2 grams of silver per joint, reduces metal consumption 15 to 20 percent, and increases working conditions.

The original technological process for drawing that was developed at the production association Kislorodmash calls for the nontraditional use of the method that is currently used in metallurgy and machine building to produce precision blanks for details. The new process makes it possible to replace the machining (planing, grinding, lathing, etc.). The drawing process for ferrous and nonferrous rolled stock increases labor productivity three- to sevenfold. A savings of metal amounting to 20 to 40 percent is achieved thanks to the reduction or elimination of allowances for finishing machining. After drawing, the components' precision achieves a surface roughness quality equal to Ra = 0.32 to 1.25 μm. The yearly savings of metal amounted to 128 tons, and labor intensity was reduced by 32,200 norm hours, thus freeing the equivalent of 16 workers.

The rolling method developed makes it possible to produce components from copper-containing alloys with a surface roughness Ra = 0.63 to 1.25 μm and with turnkey threaded sections, flat spots, and faces. Cross-wedge rolling makes it possible to manufacture different types of bodies of revolution with a shape that is complex in its axial cross section. The savings in nonferrous metal at the production association amounted to 97 tons, labor intensity was reduced by 42,000 norm hours, the equivalent of 21 workers were freed, and the yearly economic impact amounted to 120,000 rubles.

The scientific production association RostNIITM has presented a system for the computer-aided design [CAD] of control programs for gas cutting sheets for a Kristall-type unit in the presence of an Iskra 226 microcomputer. The system is distinguished by its use of a microcomputer and its interactive operating mode. The system is written in the language skoropis [fastwrite], and it operates under the control of the skoropis operating system. Introduction of the CAD system resulted in a savings of 24,000 rubles, a savings of 152 tons of metal, and the freeing of the equivalent of 4 technologists.

The CAD system for a production process to cut sheets (developed by the scientific production association rost-NIITM) is intended for calculating the dimensions of rectangular billets, designing schemes for laying and spacing sheets on guillotine cutters, and the production processes entailed in laying and spacing and automated sketching. The schemes are designed by a set of optimization algorithms with the application of technological restrictions. The CAD system for the production process of cutting sheets optimizes the cutting process and increases the level of the design processes' automation up to 85 percent. Introducing the system has reduced the labor intensity of design and shortened the time required for the technological preparation of production. The metal savings is up to 7 percent. The economic impact each time the system is introduced ranges from 50,000 to 100,000 rubles depending on the amount of material being cut. The system is recommended for machine building and instrument making enterprises with mass, large-series, and series production.

The scientific production association RostNIIM developed a production process for manufacturing gears with a modulus of 2.5 mm by cold deformation. The distinguishing feature of the method is that the teeth are formed by form rollers at the moment that the metal of the blank is in a plastic state. Using rolled rims in composite gears makes it possible to manufacture the hub from inexpensive, readily available materials: pig iron and plastics. The operating reliability of rolled rims is 60 percent higher than that of milled rims, the resultant metal savings amounting to 10 percent. Plans call for introducing them at the Yelgavselmash Plant in 1990.

The Kommunarsk Mining and Metallurgy Institute developed flexible manufacturing complexes for the pulsed cold breaking of metal sections and thick-walled pipes into measured blanks in a cold state. Carbide, alloyed, construction, and tool steels, pig irons, and aluminum, titanium, and other alloys may be cut. The complexes replace saws, lathing-cutting and abrasive cutting machines, cutting presses with warming furnaces, and gas-oxygen and other types of cutting.

Their principal technical and economic indicators are as follows: waste-free cutting and a 5 to 8 percent saving of metal; a productivity that is 20- to 30-fold higher than saws and gas-oxygen cutting; the freeing up of workers, production areas, and equipment; an increase in the geometric precision of blanks and their precision from the standpoint of mass as compared with gas-oxygen and transverse cutting on cutting presses; a 4- to 5-fold reduction in power consumption; a reduction in tool consumption; and an improvement in working and ecological conditions. The annual economic impact from introducing one complex ranges from 120 to 500 thousand rubles depending on the type size.

Resource-conserving technologies for regenerating and hardening rolling stock components have been developed by the locomotive planning-design-technology office. Plasma spraying technology is used to regenerate components. The technological process entailed in the regeneration includes the following: preliminary lathing of the worn surface, degreasing, abrasive stream machining, plasma spraying, and polishing. A head for the knuckle connecting rod of a diesel locomotive's engine was demonstrated as an example of the regeneration technology introduced. The regeneration of this and several other components of diesel locomotives makes it possible to reduce imports of spare parts and eliminate the holding of rolling stocks for repair due to the absence of necessary parts. The economic impact from regenerating one component is 450 rubles. It is 150,000 rubles when calculated for the yearly repair program.

The Perm Polytechnic Institute has proposed impregnating abrasive wheels with different water-based impregnator compounds and then heat treating them so as to improve the quality and productivity of grinding construction and alloyed steels and hard-to-machine materials.

The compounds developed increase an abrasive tool's strength three- to fivefold, increase grinding productivity 1.3- to 1.5-fold, facilitate the elimination of surface burns, reduce surface roughness 1.2- to 1.4-fold, reduce the consumption of the abrasive tool per unit product, and economize on expensive materials and resources. The proposed compounds offer the possibility of purposefully changing the operating properties of an abrasive too. The methods and components are protected by author's certificates No 942977, 1255412, and 1233676.

Design and Organization of Service Network for Strong Earthquakes in Turkmen SSR

18610078 Ashkabad IZVESTIYA ADADEMII NAUK TURKMENSKO SSR: SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in RussianNo 3, May-Jun 88 pp 96-99

[Article by A. G. Bondar, Dzh. Garagozov, and S. V. Karyakin, Seismology Institute, Turkmen SSR Academy of Sciences]

[Text] This article is devoted to the results of efforts to design and organize a network of seismic stations in Turkmenistan to record appreciable and strong earthquakes. We will discuss the creation of the optimum plan for a network to record strong movements, with the following conditions being taken into account: the area of the 7-, 8-, and 9-point zone; the zone of probable foci of strong earthquakes; the population density; the density of industrial facilities; etc. After taking these conditions into account, we recommended the second version of the design for a seismic station network with an allowance for previously completed work. The first version calls for designing 160 seismometric centers over a long period (3 to 4 five-year-plans). The second version is designed to be implemented in the 11th and 12th Five-Year-Plans and calls for organizing 52 centers (Figure 1). The versions examined have been coordinated with one another. Instruments for strong earthquakes have been organized and are now operating within the republic's territory as a part of that portion of the first version of the plan that has already been implemented. Thanks to the network's operation more than 30 recordings of earthquakes with intensities between 2 and 5 points have been obtained (the characteristics of the ground vibrations during these earthquakes are presented in another work). A comparison of planned and existing recording points in the Turkmen SSR with those of other republics (Table 2) showed that the Turkmen SSR ranks third in our country from the standpoint of its number of earthquake recording points.

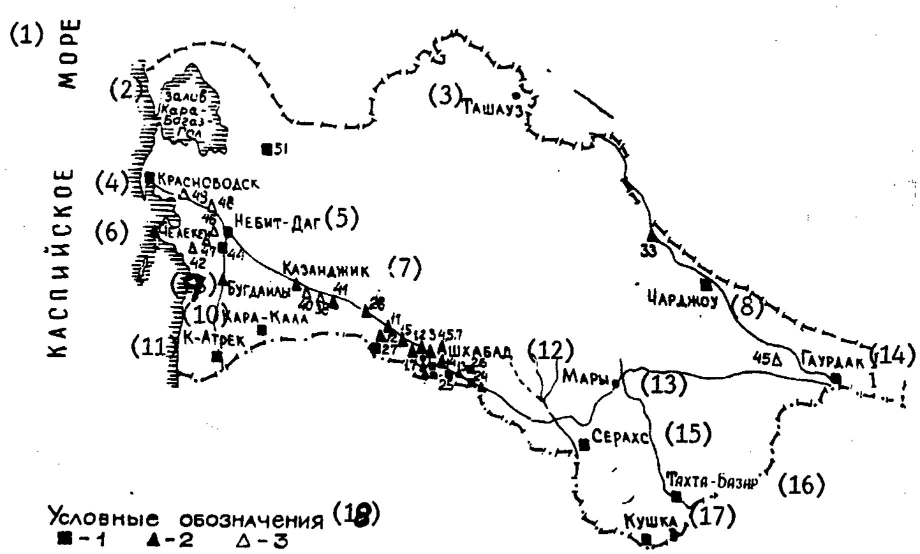


Figure 1. Network of Seismic Stations for Recording Strong Earthquakes in the Turkmen SSR

Key: 1. Caspian Sea 2. Karabdgazgol Gulf 3. Tashauz 4. Krasnovodsk 5. Nebit-Dag 6. Cheleken 7. Kazandzhik 8. Chardzhoy 9. Bugdily 10. Kara-Kala 11. Kizyl-Atrek 12. Ashkhabad 13. Mary 14. Gaurdak 15. Serakhs 16. Takhta-Bazar 17. Kushka 18. Legend

There are three types of seismometric points—stand-alone, stationary, and reference (see Table 1 and Figure 1). Stand-alone points are those that record appreciable and strong earthquakes by using only ISO-S5S or SSRZ instruments. The second type includes points that record events by using ISO-S5S and SSRZ instruments in conjunction with other instruments. The third type of station is located in those places that are most important from the standpoint of value, i.e., large cities and industrial facilities with shared or regional types of seismic stations.

Table 1. The Turkmen SSR Academy of Sciences Seismology Institute's Network of Strong Earthquake Recording Stations

Name	Stationary YeSSN[1]	Stand-alone SZSZ[2]	Existing or Planned
Keshi		+	Existing
10th microrayon		+	Existing
Ashkhabad hotel		+	Existing
Karakumstroy[3]		+	Existing
30th microrayon		+	Existing
Agric. Karadamak		+	Existing
Institute		+	Existing
Ashkhabad	+		Existing
Berzengi		+	Existing
Lake		+	Existing
Geok-Tepe (center)		+	Existing
Geok-Tepe (hospital)		+	Existing
Gyaurs (1st of May kolkhoz)		+	Existing
Annau		+	Existing
Bezmein		+	Existing
Yuzhnaya		+	Existing
Ushchelye		+	Existing
Vannovskaya		+	Existing
Nebit-Dag	+		Existing
Kizyl-Arvat	+		Existing
Kizyl-Atrek	+		Existing
Krasnovodsk	+		Existing
Ovadanepe	+		Existing
Kaushut	+		Existing
Manysh	+		Existing
Gyaurs	+		Existing
Germab	+		Existing
Bakharden		+	Existing
Kara-kala	+		Existing
Gaurdak		+	Existing
Serakhs	+		Existing
Bakharden	+		Existing
Dargan-Ata	+		Existing
Cheleken		+	Existing
Durun		+	Planned
Izgant		+	Planned
Chardzhou	+		Existing
Bami		+	Planned
Burdalyk		+	Planned
Iskander		+	Planned
Archman		+	Existing
Koturdepe		+	Planned
Khodzha-Kala		+	Planned
Kumdag		+	Existing
Kerki		+	Planned
Molla Kala		+	Planned
Monzhukly		+	Planned
Belek		+	Planned
Azizbekovo		+	Planned
Kazandzhik		+	Existing
Chagyl	+		Existing
Gaudan	+		Existing
Takhta-Bazar	+		Existing
Kushka	+		Existing

[1]Unified Seismic Observations Network; [2]Strong earthquake recording stations; [3]Karakumskiy Rayon Construction Administration

Equipment for recording strong movements within the territory of the Turkmen SSR is currently mounted in 19 stationary and 18 stand-alone stations. The equipment for recording strong earthquakes consists of sets of ISO-5S5 instruments designed to fix accelerations and two sets of HO41 + S5S instruments to record displacements.

Existing and Planned Seismometric Points for Recording Strong Earthquakes

Name	No. Points		
	Existing	Planned	Total
RSFSR	35	60	95
a) Sakhkni	6	41	47
b) IZK	13	9	22
c) Volcanology Institute	16	10	26
Tadzhikistan	37	22	59
Turkmenistan	37	15	52
Georgia	14	18	32
Azerbaijan	16	7	23
Armenia	12	0	12
Kirgiziya	14	0	14
Kazakhstan	20	0	20

The equipment to record strong movements is serviced as follows[1]: the stand-alone station network, which is located in the Ashkhabad area, is serviced twice monthly, whereas those stations that are located in individual rayons are serviced once every quarter.

The strong movement equipment mounted at stationary seismic stations is serviced daily by personnel from the seismic station. The serviceability of the equipment used to record strong movements is monitored as follows:

The geophones, feed batteries' voltage, counter, operation of the tape drive, and the optics are all checked;

Calibration recordings are made twice monthly at the seismic stations and once monthly at the stationary stations.

It is important that only two stations—Berzengi and Vannovskaya—are outfitted with an equipment set for recording strong movements that is capable of simultaneously registering velocity, acceleration, and displacement.

The lack of an exact indication of when equipment is switched on is a great flaw in the operation of existing seismic stations. At stationary seismic stations this problem has been solved by tying the equipment to continuous-recording equipment. At stand-alone stations, however, it is not yet possible to precisely establish the time at which instruments are activated.

An indicator of the activation time of instruments to record strong movements by feeding additional voltage to collimators during appreciable and strong earthquakes has been installed at stationary seismic stations. The moment at which the trigger device is activated is noted by a special circuit (Figure 2). This type of link makes it possible to keep track of the time loss from the beginning of the recording of the earthquake and its duration and also makes it possible to establish the absolute time of appreciable and strong earthquakes recorded. The experience that has been accrued in servicing the seismic station network shows that the pulse of the instruments' feed voltage affects the stability of the operation of the time mark generator on an S5S-ISO-PM oscillograph. This reduces the quality and precision of the earthquake recordings obtained.

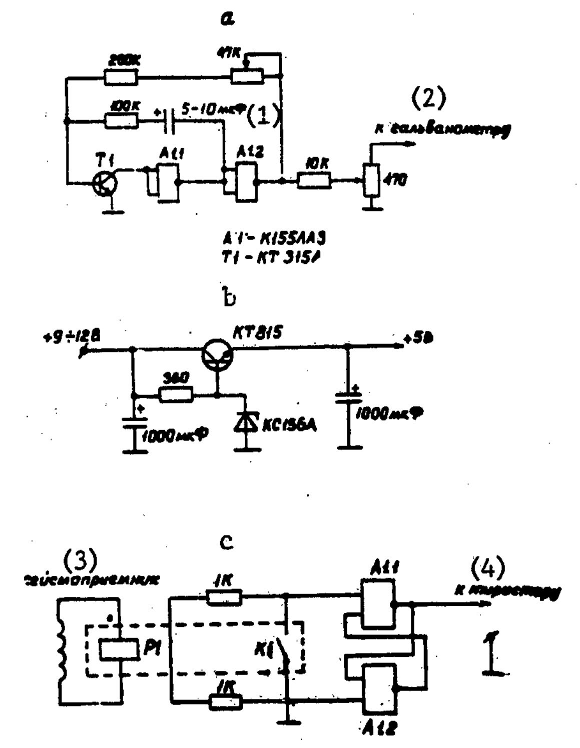


Figure 2. Electrical Circuit: Time-Mark Generator (a), Feed Voltage Stabilizer (b), and Trigger Device (c)

Key: 1. μF 2. To galvanometer 3. Geophone 4. To thyristor

Introducing the time mark generator that we developed into the circuit of an ISO-PM instrument has made it possible to eliminate the specified flaw to a voltage of 5 V, with the oscillograph's feed voltage equaling not 7.5 V as is specified in the manual[1] but rather 12 V (see Figure 2b), which increases its operating stability.

When the instruments have been serviced, it has been noted that the ISO-PM is activated against a high noise background. The reason is the lack of a triggering automaton.[2] A new version of the triggering device for the sealed-contact reed relay (see Figure 2c) was developed to eliminate this flaw.

Furthermore, plans call for using the PU-1 triggering device at those seismic stations that will be outfitted with instruments to record a full set of kinematic data on the vibrations—velocity, acceleration, and displacement. This will make it possible to simultaneously switch on all of the instruments mounted at one seismometric observation point. The triggering device will be activated from an SM-3S geophone by a high-ohm coil with a period T-1 of 2 to 6 seconds. One flaw of the PU-1 is its operating voltage of 24 V, which makes it inconvenient to provide the feed voltage at stand-alone seismic stations. It is therefore necessary to modify the PU-1 to a voltage of 12 V, which is used for the ISO and SSRZ-M instruments.

Conclusions

The material and technical base for recording appreciable and strong earthquakes within the territory of the Turkmen SSR has thus been created in Turkmenistan between 1980 and 1986. The recording service's activities will result in the collection of valuable information on strong movements, which is undoubtedly important to the tasks of forecasting the parameters of ground vibrations during earthquakes. A number of technical improvements in the equipment have been introduced during the course of the operations.

Bibliography

1. "Instruktsiya o proyadke proizvodstva i obrabotki nablyudeniy na seysmicheskikh stantsiyakh edinoy sistemy seysmicheskikh nablyudeniy SSSR" [Manual on Procedure for Producing and Processing Observations at Seismic Stations of USSR Unified Seismic Observations System], Moscow, Nauka, 1981.

2. Rozenberg, I. M., "Device for Triggering Recording Equipment at Moment of Earthquake," in "Seysmicheskiye pribory" [Seismic Instruments], Moscow, Nauka, 1973, ed. 7.

Advances, Needs in Maintenance and Repair in Machine Building Sector Discussed at Hungarian Conference

18610042a Moscow VESTNIK MASHINOSTROYENIYA in Russian No 6, Jun 88 pp 76-77

[Article by V. N. Goncharov, candidate of economic sciences: "Repair-87 Conference"]

[Text] An international scientific-practical conference, entitled "Repair-87" was held in the city of Nyiregyhaza (Hungary) in August 1987. It was organized by the Hungarian Scientific-Technical Society for Machine Building. Scholars and leading specialists in the field of repair and maintenance from institutes, design organizations, design offices, and machine building and repair enterprises in Hungary as well as specialists from the CSSR, USSR, GDR, Poland, and Bulgaria took part. Representatives of firms from Austria, Switzerland, the FRG, and Denmark presented reports at the conference's plenary sessions, and they presented diagnostic equipment used in conducting repair work.

The goal of the conference was to assess and discuss the state of the art of the maintenance and repair of technology through a wide-scale exchange of experience among specialists in the field of repair, to determine directions for further development by becoming acquainted with the most efficient methods of maintaining equipment in good working order and extending its service life, and to become acquainted with and exchange international and practical experience and progress in the field of using diagnostic equipment during repair operations.

The report presented by K. Solovari (Hungary), entitled "State of the Art and Concept for Development of Repair in Machine Building Enterprises up to the Year 2000," was especially interesting. It stressed the fact that machines, machine tools, equipment, and mechanisms with service lives of more than 20 years are now operating in the Hungarian national economy, a fact that has necessitated an increase in capital investments to keep them in working order.

Solovari noted that efforts must be directed toward the high-quality performance of repair operatioons and toward reducing the numbers of repair personnel by using automation equipment, mechanizing labor-intensive processes, and using diagnostic instruments when conducting preventive operations.

The report presented by L. Matay, general secretary of the Hungarian scientific-technical society Machine Building, dealt with problems related to increasing the complexity of repair operations, above all due to the electronization of equipment. He noted that this requires strict accounting in the documentation for equipment and the development of special methodological documents, norms, production charts, etc.

It should be noted that diagnostic equipment that will make it possible to avoid large outlays during repair operations is already beginning to be used extensively at Hungarian enterprises.

The report presented by E. Polivka (CSSR), entitled "Concept for Developing Equipment and Maintaining It in Good Working Order at CSSR Enterprises With Forecast up to Year 2000," dealt with problems of using new technology in repair. The speaker focused on the wide-scale use and introduction of computer-assisted technical diagnosis.

There was great interest in the report presented by I. Kyubayn (GDR), entitled "Trend in Development of Repair up to Year 2000 in GDR." It discussed problems related to the strategy of using adaptive equipment in the GDR's national economy and well as in CEMA member countries. He proposed developing the issues of integrated repair, specialization of individual types of operations during the repair of equipment, creation of combines for the repair of metal-cutting machine tools inside the CEMA member countries, and joint work on the part of those services that are interested in developing a repair strategy using technical diagnosis. Kyubaun also noted that specialists in the repair field should be trained in higher educational institutions as well as in vocational-technical schools.

L. Vichev (Bulgaria), director of the organization Bulgarlizing proposed the creation of a special center called Interremont [Interrepair] that would coordinate repair operations within the countries in the Socialist alliance.

Docent S. Witt (GDR) spoke of using microcomputers in repair operations. It should be noted that many specialists from the CEMA member countries have spoken of the wide-scale introduction of computer technology in the repair field, a trend that has made it necessary to pay more attention to the quality of training for specialists in the field.

V. I. Shironin, candidate of economic sciences, head of the main administration of the head mechanic and head power engineer, spoke of the experience that has been accrued by the enterprises of the USSR Ministry of Chemical Machine Building in implementing repair and preventive maintenance operations as well as in using diagnostic equipment in conducting repair operations and using a special approach in future repair services.

Trends in the development of machine building enterprises and firm repair were examined in the report presented by Doctor of Technical Sciences A. I. Fedotov (Leningrad).

Also heard at the conference was a report about improving systems for repairing equipment at machine building enterprises and about the use of these systems at our country's foremost enterprises.

During the conference, exhibitions of diagnostic equipment from such firms as Brul and Kerr and Oerlikon were organized in the Palace of Technology (Nyiregyhaza). The testing systems manufactured by Brul and Kerr, which are based on an analysis of mechanical vibrations, are widely used in preventive and regular maintenance. They facilitate a significant reduction in equipment downtime and reduce costs.

The conference organization committee organized roundtable talks to allow foreign delegates to exchange experience, publicize their scientific and technical progress in the implementation of repair operations, and reach an agreement on matters related to conducting scheduled conferences in the CEMA member countries.

The conference participants visited one of the repair enterprises in Nyiregyhaza. There they became acquainted with an organization for repairing metal-cutting machine tools under contract with Hungary, the CSSR, the GDR, and Poland. Besides major overhaul, the customer can request that a machine tool be additionally equipped with computers.

Participation in the international conference Repair-87 helped expand scientific ties and establish contacts with scholars and specialists from the CEMA member countries. It also developed participants' horizons and expanded their scientific knowledge.

The next such conference for CEMA member countries, Repair-88, is slated for November 1988 in Dresden (GDR).